Gould
PC 0185 Programmable Controller

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GOULD 0185

PROGRAMMABLE CONTROLLER GUIDE

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PC 0185 PP 0110

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INTRODUCTION

Gould is a global company offering many products in diversified markets. In each market segment, Gould is among the best and is deeply committed to excellence in it's ability to field superior products.

In the industrial control market segment, Gould is both a pioneer and a leader. Our automated factory control devices have been proven in all kinds of service environments around the world. The Gould PC Division prides itself on quality and integrity. Our product line benefits from the special attention we routinely give to reliability, ensuring that costly down time is kept to an absolute minimum.

We have world-wide sales offices and support centers that give our customers the added security of knowing that should an unlikely failure occur, we stand ready, willing, and able to help you quickly diagnose the problem and correct the malady. What's more, we have an extensive field and in-house training net that is specifically designed to meet client needs for effective job skills.

Gould has tackled all kinds of problems and can tackle yours. We're a team of experts who constantly strive for competitve advantage. We're imaginative and innovative. We have a history that we're proud of and a future that promises growth. We have the kind of people who turn problems into challenges. We have the kind of people whom you can rely upon to deliver the kind of quality product, backed by service, that today's manufacturer requires.

With the introduction of the PC 0185, Gould offers a powerful manufacturing control system for smaller control applications. Thanks to recent developments and advancement of the semiconductor technology, we are proud to announce release of our Eliminator Series Programmable Controller with advanced features implemented in a small package. The I/O module for example is about 2 inches thick, weighs about 2 lbs., and can be housed in an area the size of this page. A full system has 192 local and 320 remote I/O points, and features a 3.5K word memory for programming with a fast scan time of 1.6 microseconds per word. The Gould PC-0185 system offers a full line of I/O capability ie, AC/AC, AC/DC, DC/DC, DC/AC, AC/Relay, and DC/Relay. For mid-size control applications, the Gould PC 0185 offers a powerful, very high degree of sophisticated control in a very compact package.

- The small size of the PC 0185 permits installation inside a vented space-tight cabinet.

  The I/O modules are approximately 5.9" x 8.3" x 2.36". I/O modules can be expanded vertically with a contiguous module, or horizontally via a 2'4" (70 cm) cable.. Input power can range from 85 to 250 VAC without any switches or voltage selection jumpers. A switch selectable power fail sensing circuit is provided to detect the loss of input voltage.

- Choice of local I/O expansion from 24 to 192 points (in increments of 8 points).

  This provides flexibility with a variety of I/O modules. Because you can choose from 24 point and 32 point modules, you can expand according to your needs, optimizing cost and performance of the system. Relays, transistor, and triac outputs are available in 1/2, 1, 2 amp, and isolated configurations.

- Thanks to the powerful application instructions, 3.5 K Words of memory, and a fast scan time, the PC 0185 can be used for sophisticated control.

  The use of a custom LSI provides the CPU with a high degree of computer performance with a scan time of 1.6 microsecond per word. The PC 0185 is able to perform sophisticated control using 12 basic instructions and 42 higher level application instructions. The program can be stored in EPROM to prevent unauthorized changes. The basic system has 128 timers/counters and 256 registers in battery backed CMOS RAM.

CHAPTER 1 - SYSTEM INSTALLATION RECOMMENDATIONS

1. The unit should be installed in an area where:

   - it is not exposed to a direct sunlight.
   - the humidity does not exceed a range of 35 to 90%RH non-condensing.
   - no corrosive or flammable gases exist.
   - there is no direct, heavy vibration.

2. This equipment operates properly within a temperature range 32° - 130°F of (0 to +55°C.)

3. Before touching the PC directly, discharge static electricity by touching grounded metal first.

4. Fasten all screws securely.

5. Never use organic solvents (like thinner or gasoline) to clean the unit.

6. Never push the keypad with a sharp pointed item (like a pencil point).

7. The keypad must be kept away from welding sparks and hot solder.

8. Keep the interface cable that connects the controller to the programmer away from high voltage, power supply, I/O signal, and the system's power supply lines.

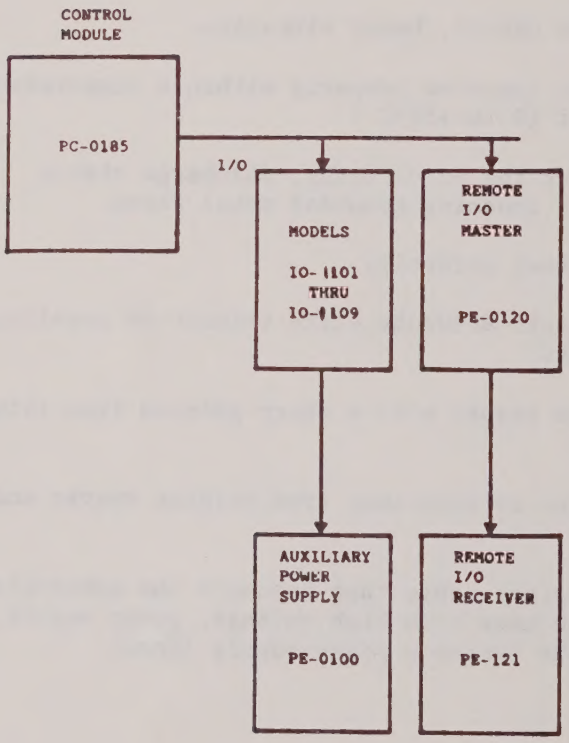


Fig. 1, Network of PC 0185 Product Family.

System Design

The procedures required for designing a control system operated by the PC 0185 controller is similar to those of any relay sequence controller.
A typical example is shown below.

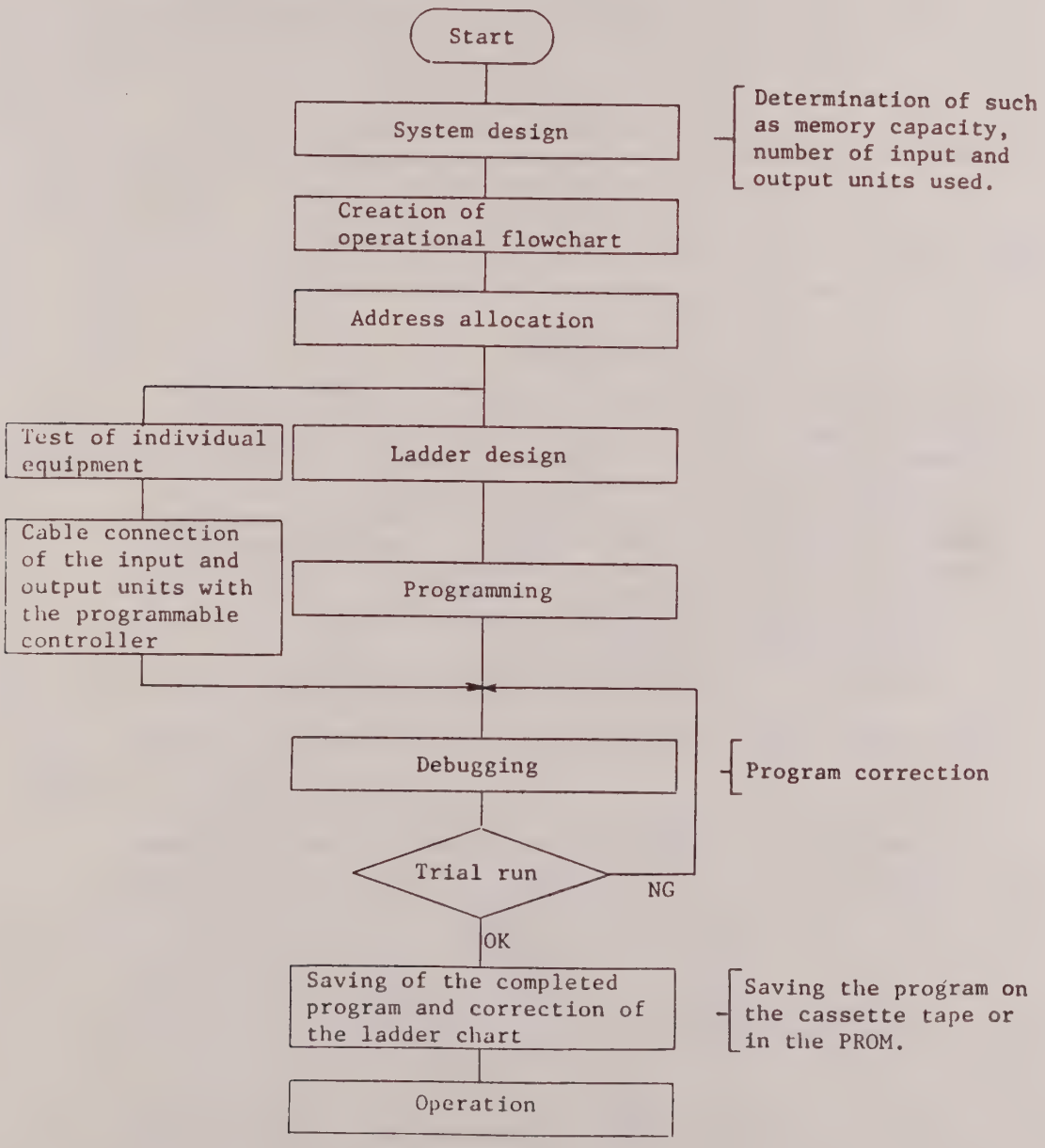

Start
System design
Determination of such as memory capacity, number of input and output units used.
Creation of operational flowchart
Address allocation
Test of individual equipment
Ladder design
Cable connection of the input and output units with the programmable controller
Programming
Debugging
Program correction
Trial run
NG
OK
Saving of the completed program and correction of the ladder chart
Saving the program on the cassette tape or in the PROM.
Operation

Fig. 2, Program Design Flowchart

System Design Considerations and Safety

The main difference between a PC and a conventional relay circuit is that the PC handles the control program in a cyclic manner (serially), while the relay circuit processes in parallel.

The PC's programming elements should not include any critical components. Your application must provide fail-safe mechanisms that are independent of the PC's program.

The circuits described below should be established outside the PC:

- Emergency stop circuit
- Protective circuits
- High voltage operating circuits
- Other circuits that prevent human injury and/or
- mechanical failures

The response time of the PC must be considered when making fail safe plans.

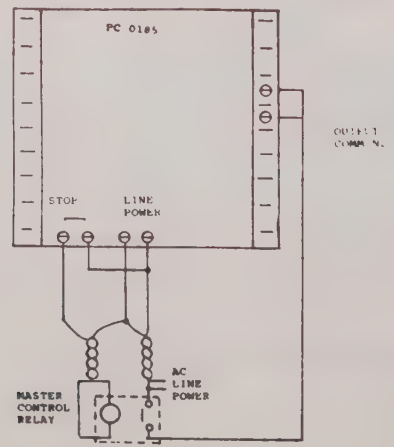
CAUTION

The PC 0185 Controller is configured in the factory with all outputs in the retentive state. This means that if an output is ON when a logic scan stops (changing from RUN mode to STOP mode via the programmer, or if there is a diagnostic failure), it will remain ON. In some applications this may be undesirable or dangerous. The control system designer is responsible for PC operation and safety. There are two methods of making all outputs non-retentive.

1. To turn all of the outputs OFF when the scan stops set system address #203 to 377.
Procedure: Press keys as in the sequence shown

*, *, PROG MODE, 8/SET, CLEAR, SYS MEM, 2, 0, 3, MON, 3, 7, 7, ENTER

2. To turn all of the outputs OFF when the scan stops, power all of the output field wiring from a master control relay contact. The master relay is controller by the HALT output terminals on the PC 0185 terminal connector.



Power-Up Procedure

When power is applied, the power failure signal stays low for 10ms after the 5V supply is fully oeprational. The machine will then initialize the data memory. During the initialization, the data memory defaults to the following limits.

Data Memory	Address	State After the Initialization
I/O relays	0000~0777	Enables to set system memory #200 the keep function starting address. Address before specifying the latch function → ALL OFF Address after specifying the latch function → Retains the ON/OFF state before a power failure is encountered.
Link relays	2000~2777	
Auxiliary relays	4000~4777	
Latched relays	7000~7377	
TMR,CNT,MD	000~177	TMR: Enable to set system memory #201 the state at the time of power on. 000 --- The preset value takes place of the current value. 001 --- The value retained after the power interrupt takes place of the current value. The TMR contact retains the ON/OFF state before the power failure. CNT: The state before the power interrupt takes place of the current value. The CNT contact retains the state before the power failure. MD: Both the MD data and input information retain the state before the power interrupt.
Register	9000~9377	Retains the value before the power interrupt.
File register	30000 ~ 33777	Retains the value before the power interrupt.

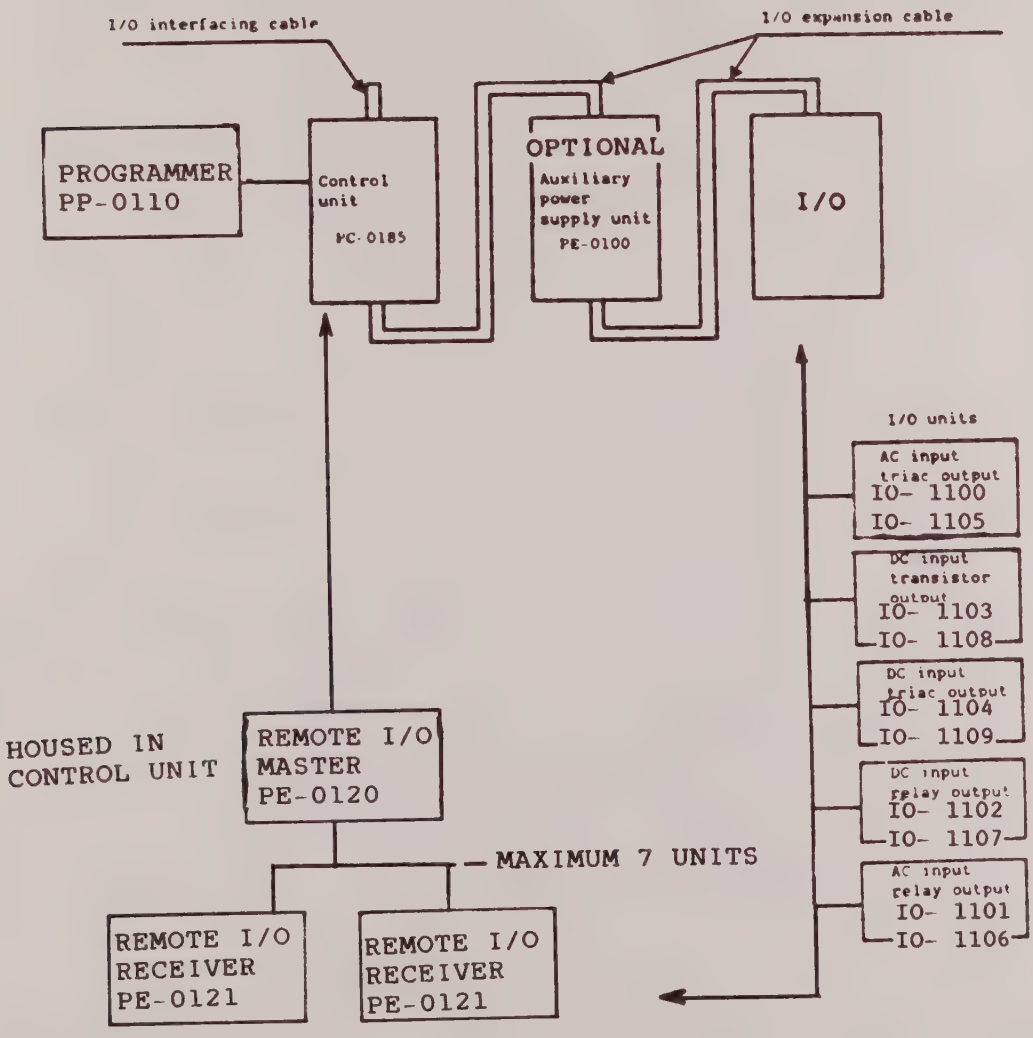
NOTE-1: At power up, output data latch of all output units will be reset and all outputs turned OFF prior to the initialization process.

NOTE-2 The data memory is initialized at power up, However the data memory I/O relay area is changed in the following ways by the I/O execution of the first scan:
(a)Area to which the input unit is interfaced or turns ON or OFF according to the ON/OFF state of the input device (such as the limit switch) connected to the input unit.

(b)Area to which the output unit is interfaced and the input/output unit is not yet interfaced. Does not change from the state of the initialization until it goes into the user program execution phase.

CHAPTER 2 - SYSTEM CONFIGURATION, COMPONENTS & CONTROLLER SPECS.

The basic system architecture of the PC 0185 system is shown below:



Note: Up to six I/O units may be connected to one controller. Modules with relay outputs must connect either to the controller or an auxiliary power supply.

List of available units

Unit name	Model No.	Description	Accessory Item	Qty.
Control unit	PC0185	Contains CPU, memory, power supply. 3.5 K words program memory (7KB) +5 VDC 4.3 A } power +24 VDC 0.8 A } supply	Glass tube mini-fuse, 250VAC 1A Glass tube mini-fuse, 250VAC, 2A Screws Instruction manual I/O unit Interfacing cable	1 1 4 1 1
Auxiliary power supply unit	PE-0100	+24 VDC, 0.8 A power supply	Glass tube mini-fuse, 250VAC, 1A Screws	1 4
I/O unit	IO-1100	16-110/120 VAC inputs 16-110/120 VAC, 1 A, triac outputs	Metal Joining Plate and Screws Terminal ID label	1 2 2
	IO-1103	16-24 VDC inputs 16-12/24 VDC, 0.5 A, transistor outputs	Metal Joining Plate and Screws Terminal ID label	1 2 2
	IO-1104	16-24 VDC inputs 16-110/120 VAC, 1 A, triac outputs	Metal Joining Plate and Screws Terminal ID label	1 2 2
	IO-1102	16-24 VDC inputs 16-250 VAC (max)/ 30 VDC (max), 2A, (resistance load) relay outputs	Metal Joining Plate and Screws Terminal ID label	1 2 2
	IO-1101	16-110/120 VAC inputs 16-250 VAC (max)/ 30 VDC (max), 2 A, (resistance load) relay outputs	Metal Joining Plate and Screws Terminal ID label	1 2 2

Unit name	Model No.	Description	Accessory Item	Qty.
I/O unit	IO-1105	16-110/120 VAC inputs 8-250 VAC (max), 2 A triac outputs	Metal Joining Plate and Screws Terminal ID label	1 2 2
	IO-1108	16-24 VDC inputs 8-12/24 VDC, 2 A, transistor outputs	Metal Joining Plate and Screws Terminal ID label	1 2 2
	IO-1109	16-24 VDC inputs 8-250 VAC (max), 2 A, triac outputs	Metal Joining Plate and Screws Terminal ID label	1 2 2
	IO-1107	16-24 VDC inputs 8-250 VAC (max)/30 VDC (max), 2 A, (resistor load) relay outputs	Metal Joining Plate and Screws Terminal ID label	1 2 2
	IO-1106	16-110/120 VAC inputs 8-250 VAC (max)/30 VDC (max), 2 A, (resistor load) relay outputs	Metal Joining Plate and Screws Terminal ID label	1 2 2
Programmer	PP-0110	LCD matrix dot display programmer	0185 Control unit interface cable (3 meters) 0085 Control Unit Interface cable Cassette tape recorder interface cable (1.5 meters) Connector locking springs Programming Guide	1 1 2 1
Remote I/O Master Module	PE-0120	Permits connection of up to 7 slave units.	screws	4
Remote I/O Receiver	PE-0121	Mounted inside the Control Unit. Contain the power supply unit within the unit. Maximum 128 I/O points.	Glass tube mini- fuse (250 V, 1 A) Glass tube mini fuse (250 V, 2A) Screws I/O interface cable	1 4 1

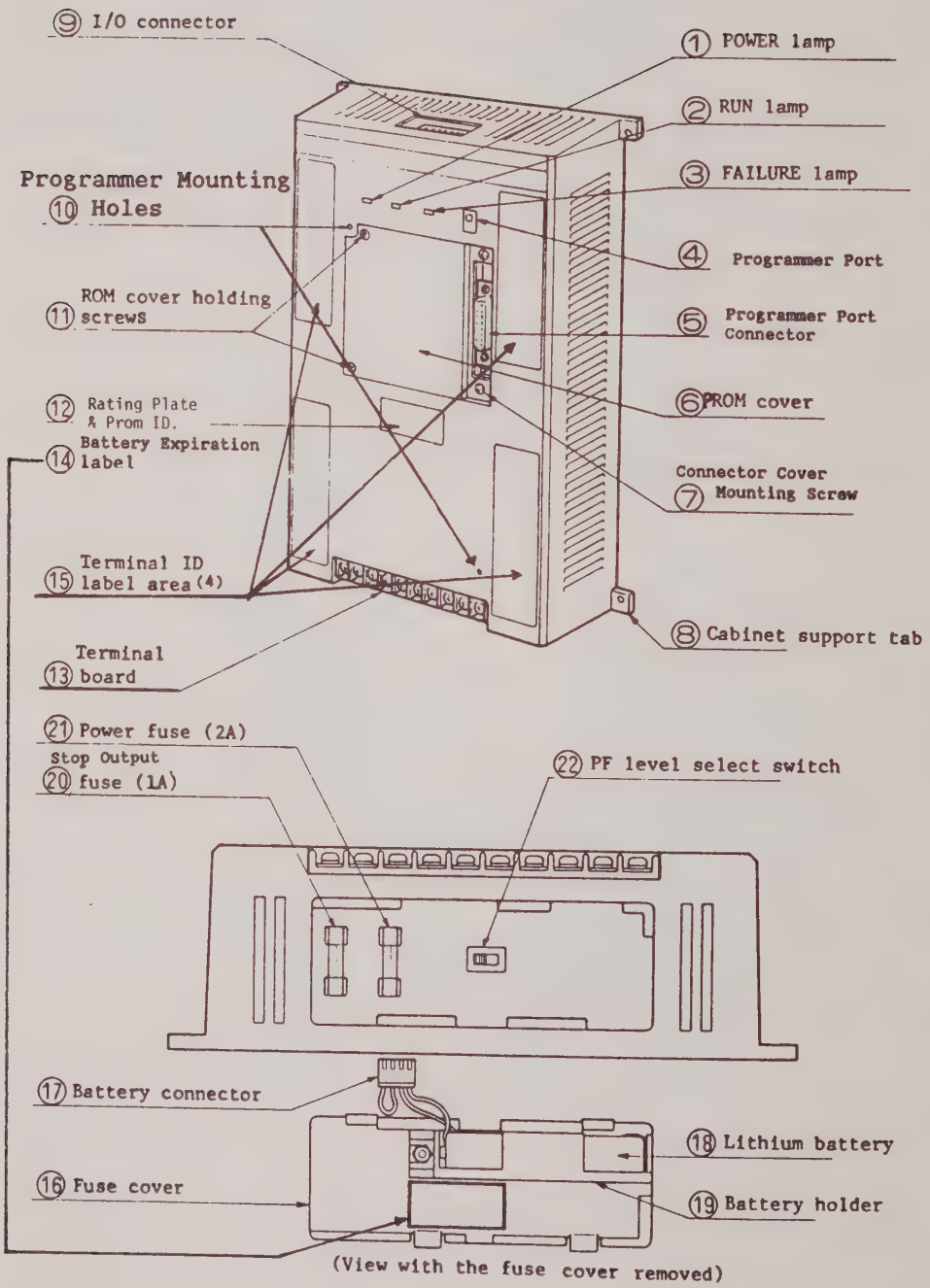


Fig. 3, PC 0185 Control Unit Parts Identification

(1) POWER lamp (green)
ON when the internal +5 V power supply is ON.

(2) RUN lamp (green)
- Continuously ON when operated normally.
- Flickers during programming, provided that the PC operation is not running.
- OFF when an abnormal condition is detected by the self-check function; but ON for a battery failure.

(3) FAILURE lamp (red)
ON when an abnormal condition is detected by the self-check function and the PC stops its operation (except for a battery failure).

(4) PROGRAMMER ON/OFF switch
The switch is set to the OFF position when the Programmer is to be connected or disconnected. When the switch is set ON, signal transfer is permitted between the programmer and the controller.

(5) Programmer Connector
Used to connect a programmer (PP 0110) to the controller.

(6) PROM cover
The cover has to be removed to mount the PROM chip onto the PROM socket (for PROM controlled operations only).

(7) Connector cover holding screw (two)
Used to secure the support tool interfacing connector.

(8) Cabinet support tab
Used to hold the control unit to the pair of I/O units.

(9) I/O connector
Used to connect the controller to an I/O unit using the interfacing cable that comes with the unit.

(10) Programmer mounting screw holes
Screw holes used for direct mounting of the programmer to the control unit.

(11) PROM cover holding screw (two)
Screw used to secure the PROM cover.

(12) Rating plate

(13) Terminal board (10 terminals)
Used for connecting 115VAC input power, 24VDC out, Stop output, and remote/link communications.

(14) Battery expiration label
Indicates the expiration date of the memory backup battery cell. The cell should be replaced with a new one before the expiration date on the label. The label has to be replaced with a new label indicating a new expiration date.

(15) Terminal ID label area
I/O unit terminal ID label must be bonded on these areas when the control unit is installed to the I/O unit pair.

(16) Fuse cover
The cover needs to be removed in one of the following conditions.
- When changing the PF switch setting.
- Replacing the fuse(s).
- Replacing the battery cell.

(17) Battery connector
Memory retention power is supplied from the lithium battery through this connector when there is a power supply failure.

(18) Lithium battery
Memory backup battery required to retain memory contents in case of a power supply failure. The battery cell should be replaced with a new one before the expiration date noted on the label.

(19) Battery holder
Holds the lithium battery cell to the fuse cover.

(20) STOP output fuse (1 A)
250V/1A, glass tube, mini-fuse is used for the STOP output line.

(21) Power fuse (2 A)
250V/2A, glass tube, mini-fuse is used for the primary power supply line.

(22) Power Fail (PF) level select switch
With this switch it is possible to set the power failure level detection to 85 VAC for 110 VAC operation, or to set detection at 170 VAC for 220 VAC operation. The switch has been set to 85 VAC at the factory.

The physical dimensions of controller and the I/O mounted to controller is shown in the following figure.

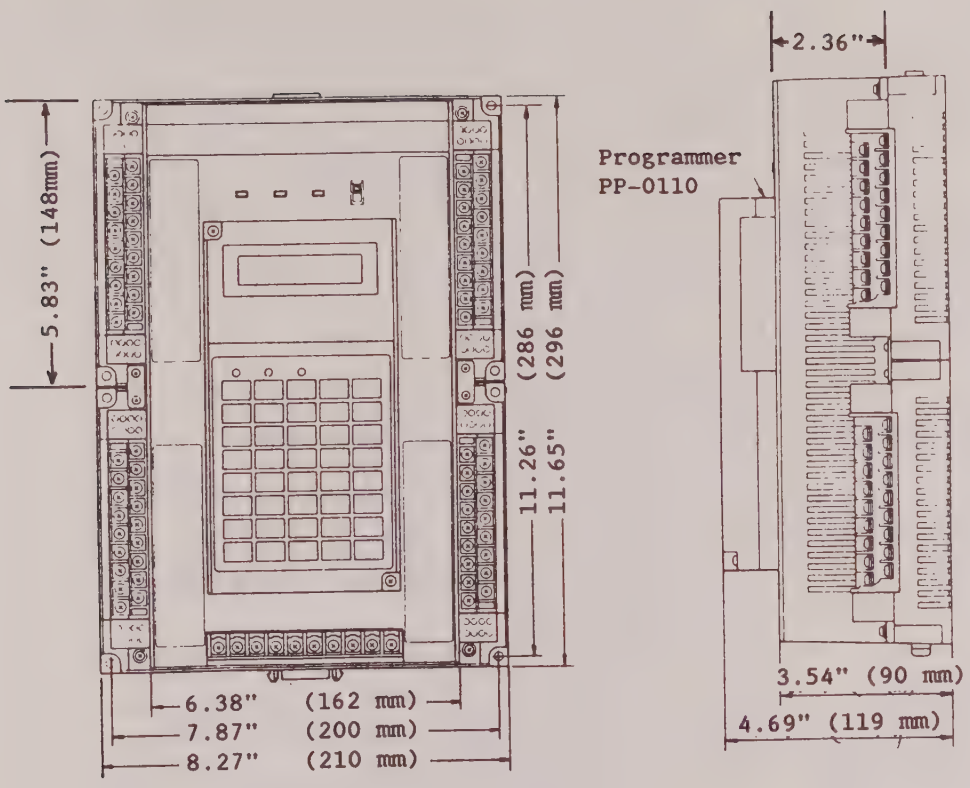


Fig. 4, Dimensions (mm) of I/O Units and Controller

General Controller Specifications

Item	Specification
Operational temperature range	(0 - 55°C) 32 - 131°F
Storage temperature range	(-20 - 70°C) -4 - 158°F
Humidity rating	35 - 90% RH, non-condensing
Atmosphere	Free from corrosive and flammable gas
Vibration	16.7 Hz @ 3mm amplitude (2 hours for each x, y and z axes)
Impact	Complies with JIS C 0912
Noise immunity	1,000 Vp-p, 1 uS (by noise simulator between the power lines and base)
Dielectric strength	1,500 VAC, 50/60 Hz, one minute, between all terminals and base.
Insulation resistance	Minimum 10M ohms with 500 VDC megger between all terminals and base.
Input voltage range	85 - 250 VAC (No Voltage switch selection required) 55 Hz +/- 7 Hz
Power consumption	Maximum 70 W
Allowable power failure time	Maximum 10 ms (at 120/240 VAC)
Ground Requirement	Class 3 ground, Maximum 100 ohms
Weight	Approx. 3.7 lbs (1.7.Kg). I/O Module: Approx. 2.0 lbs (0.9 Kg)

Performance Specifications for Controller

Item		Specification	
Control system		Stored program system (cyclic operation)	
Programming method		Boolean implementation of ladder logic	
Scan time		Basic instructions except the timer, counter, maintenance display (MD), and application instructions: Approx. 1.6 us/word (Note): scan time for only the basic instruction set: 2.5K words: Approx. 5ms 3.5K words: Approx. 6.7 ms	
Instruction set		12 basic instructions 42 application instructions	
User memory size		RAM 3.5K words (7KB)	
Memory element		Battery back up CMOS-RAM or EPROM	
Battery		Lithium battery	
Number of control input points		96 points at maximum (local I/O)	
Number of control output points		96 points at maximum (local I/O)	
Inputs/Outputs		512 points (0000 - 0777)	].000 -].077
Internal control relays	Link	512 points (2000 - 2777)	].200 -].277
	Regular	512 points (4000 - 4777) Replaceable with retentive relay in increment of 8 points each	].400 -].477
	Retentive	224 points (7000 - 7337)	].700 -].733

Special internal relays	Non-carry flag	(address 7354)
	Error flag	(address 7355)
	Carry flag	(address 7356)
	Zero flag	(address 7357)
	0.1 second clock	(address 7360)
	1.0 second clock	(address 7364)
	Preset value change switch	(address 7365)
	Zero-cross switch	(address 7367)
	Parity error	(address 7370)
	CPU failure	(address 7371)
	Battery failure	(address 7372)
	I/O failure	(address 7373)
	Option failure	(address 7374)
	ROM failure	(address 7376)
	Power supply failure	(address 7377)
Timer Counter MD	Total 128 points (000 - 177) b000-b377 Timer range: 0.1-199.9 seconds Counter range: 00001 - 19999 MD range: 000 - 999 Current counter and MD values are retained during power failure.	
Register	256 bytes (9000 - 9377) of 8-bit structure and register contents are retained during power failure.	
Special register	One-byte (]734) - Stores error codes	
File register	2K byte auxiliary register made available when Program Memory area is reconfigured from 3.5K to 2.5K words.	

Item		Specification							
Item	Function	PC operating status	STOP output	Indicator RUN	Indicator ERROR	Indicator POWER	Special relay	Error code Special register] 734	Error code System memory
Memory	Parity check	Halt	Open	OFF	ON	ON	7370	20	21
CPU	Watchdog timer								31
	RAM check (R/W)								32
	Parity check						7371	30	33
	ROM check								34
	Hardware check								35
Input/ output	I/O data bus						7373	40	44
	I/O Module								45
Power supply	Power failure/ voltage drop				OFF	OFF	7377	10	13
Optional Module	Module failure				ON	ON	7374	50	53
Battery	Battery voltage drop	RUN	Closed	ON	ON	ON	7372	20	22
STOP output	100/200VAC, 1A, triac output. ON (closed) during PC operation								

The latched relay area, 7300 - 7337, will also be used as the special relay area when an option module such as computer link, data link, or remore I/O is used.

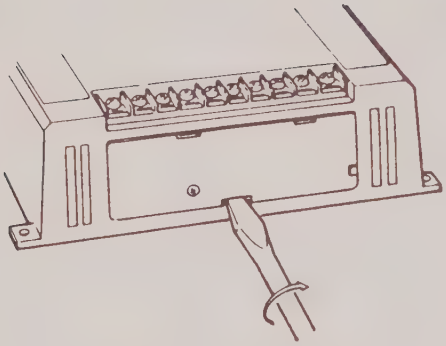
PF (power failure interrupt) Selection

Since the power supply sequencer circuit is incorporated in the power supply unit, it prevents the malfunction of the controller caused by supply voltage drop or instantaneous power interruption.

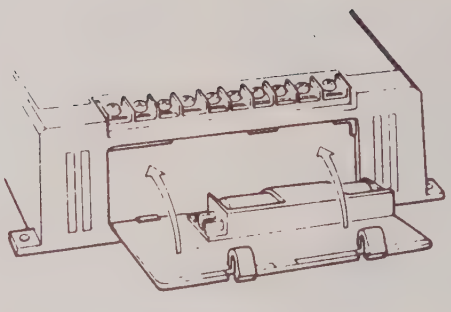
The unit does not respond to a power failure of less than 10 milliseconds (about half the power supply cycle). If a failure of more than 10mSec should occur, the controller stops and all outputs are turned OFF.

A gradual drop in the supply voltage makes the control unit stop and all outputs are turned OFF when input power goes below 85 VAC.

The PF level select switch was factory set to the 85 VAC side. Change the switch setup when it is operated at more than 200 VAC.



Removing the fuse cover



Replacing the fuse cover back

PF Change Procedure:

1) Insert the screwdriver into the slit under the fuse cover and turn it to remove the fuse cover.

2) Set the PF level select switch to right (170 VAC side).

3) Replace the fuse cover.

See the table below for the PF level when the PF level select switch is set to the 85 VAC side and 170 VAC side.

Switch position	PF level
85 VAC	80 to 84 VAC
170 VAC	160 to 168 VAC

Power Supply Description

Power Failure Levels for Master Power Supply

The master power supply contains logic which prevents controller unit malfunctions resulting from supply voltage drops. The controller unit will not respond to a power failure of less than 10 ms. If the supply voltage drops below the power failure level, the controller unit also shuts off all its control outputs. The following shows the power failure threshold levels (selectable with the switch.)

Switch position	PF level
85 VAC (left)	80-84VAC
170 VAC (right)	160-168 VAC

Notes Regarding an Additional Power Unit

The DC input unit and/or relay output unit are powered by a +24VDC power unit built into the controller unit. This power unit has a maximum output capacity of 0.8 A. If the load current exceeds this value, unusual heat dissipation or a voltage drop will result in the controller unit. If the total power consumption of the installed I/O unit is expected to exceed 0.8 A, an additional power unit with a rated output capacity of 0.8 A must be used. An additional power supply unit is required for every two relay output units. (When three IO-1102 units are used, at least one additional power unit is required.)

Item	Specifications
Input power	85 to 250 VAC (usable without switching)
Surge current	15 A (at 100 VAC)
AC leakage current	Not more than 1 mA at 240 VAC (ammeter's input impedance: 1K)
Output voltage and current	5 V, 0 to 4.3 A (5±0.2 A with the master power supply only) 24 V, 0 to 0.8 A
Overcurrent protection	Fuse for master power supply (STK 7404 for additional power unit)
Output hold time	Not less than 8.5 ms
Output rise time	Not more than 200 ms
Dielectrical strength	1500 VAC for 1 minute (across external high-voltage terminal and chassis)
Insulation resistance	Not less than 10 M with a 500 VDC Megohm meter (across the external high-voltage terminal and chassis)
Operating temperature	0 to 55°C
Cooling	Natural air cooling

The rated power output from the power supply unit inside the PC-0185 control unit is 5VDC @ 4.3A and 24VDC @ .8A. The rated output from the PE-0100 Auxiliary Power Supply unit is 24VDC @ .8A. Use of I/O units beyond this limit causes excessive temperature rises within the power supply and thermal fuse failure in the power supply circuit. It may also lead to a malfunction because of a supply voltage drop caused by the current limiter circuit. In the course of system design, it is necessary to ensure that the total power consumption is below this limit.

Model Name		24VDC supply	
		Power consumption when all points are ON 1 (ON) (mA)	Power consumption when "n" points are ON 1 (ON) (mA)
IO-1100			
(16 AC inputs	Input	---	---
16 triac outputs)	Output	---	---
IO-1103			
(16 DC inputs 16 -	Input	160	10n
transistors output)	Output	---	---
IO-1104			
(16 DC inputs	Input	160	10n
16 triac outputs)	Output	---	---
IO-1102			
(16 DC inputs	Input	160	10n
16 relay outputs)	Output	240	15n
IO-1101			
(16 AC inputs	Input	---	---
16 relay outputs)	Output	240	15n
IO-1105			
(16 AC inputs	Input	---	---
8 triac outputs)	Output	---	---
IO-1108			
(16 DC inputs 8 -	Input	160	10n
transistor outputs)	Output	---	---
IO-1109			
(16 DC inputs	Input	160	10n
8 triac outputs)	Output	---	---
IO-1107			
(16 DC inputs	Input	160	10n
8 relays outputs)	Output	120	15n
IO-1106			
(16 AC inputs	Input	---	---
8 relay outputs)	Output	120	15n
PE-0120 Remote I/O Master		---	
PE-0121 Remote I/O Receiver		---	

NOTE-1: Make sure that not more than 82 outputs are ON at one time when using six IO-1100 modules, a PE-0120, and programmer in a local configuration.

NOTE-2: The PE-0100 Auxiliary Power Supply is required when more than two units of the following are used: IO-1101, IO-1102, IO-1106, or IO-1107.

Example 1:

PC-0185	(control unit)	
PC-0110	(programmer)	
IO-1100	(16 AC, 16 triacs)	---------- 4 units
IO-1107	(16 DC, 8 relays)	---------- 2 units

24VDC supply

IO-0107 (0.16+0.12)X2=0.56 (A)

Since 0.56 is less than 0.8A, loading is acceptable.

Example 2:

PC-0185	(control unit)	
PC-0110	(graphic display programmer)	
IO-1100	(16 DC, 16 triacs)	---------- 3 units
IO-1107	(16 DC, 16 relays)	---------- 3 units

24VDC supply

IO-0100	0.16X3 = 0.48 (A)
IO-0107	(0.16+0.24)X3 = 1.2 (A)
	Total 1.68 (A)

The rated current for 24VDC when one auxiliary power supply is added will be 1.6A (0.8 + 0.8).

In example 2, the 1.6A limit is exceded by 0.08A. In such a case, it is suggested that you examine the maximum number of I/O points which turn on at the same time. Then determine whether only one extra power supply is really required.

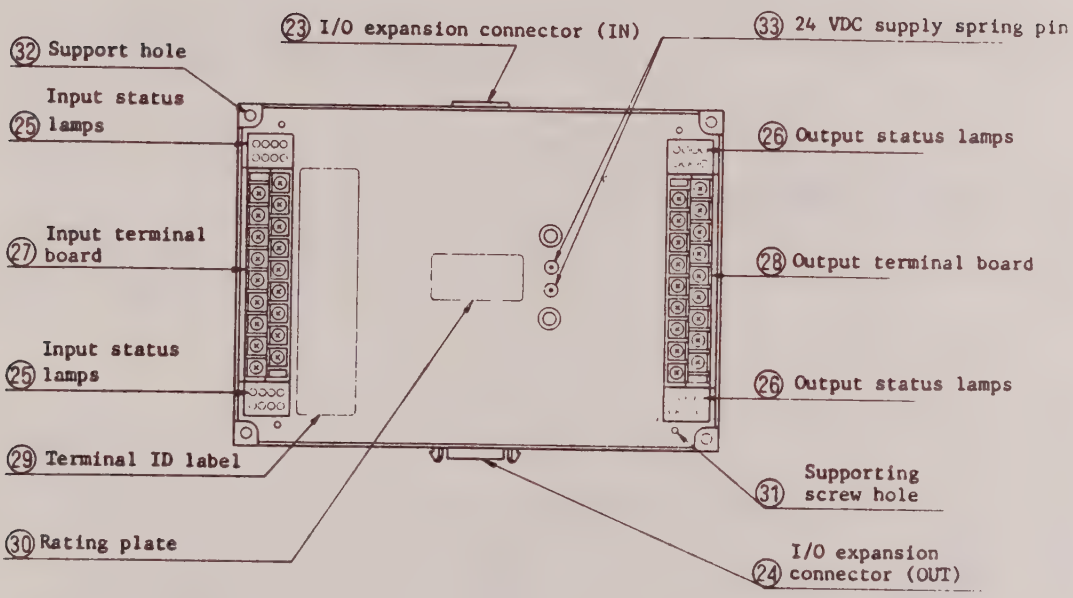
The current required to turn on 80 points (out of 96 DC inputs of IO 1107) is determined in the following manner:

$$1.68-\{(96-80)\ X\ 0.01\} = 1.52(A)$$

There is no need to use an auxiliary power supply unit since the total power consumption in this case is below 1.6A. However, care must be taken not to exceed more the current rating of 0.8A for each of power supply units. Note that this 80mA for the 24VDC output on the terminal strip.

CHAPTER 3 - I/O CONFIGURATIONS AND SPECIFICATIONS

Parts Identification and Functions:



Item

(23) I/O expansion connector (IN)
Used to connect the cable between the control unit, other I/O units, and I/O expansion cables.

(24) I/O expansion connector (OUT)
Used to connect other I/O units and I/O expansion cables.

(25) Input status lamps
LED used to indicate the status of an input device.

(26) Output status lamps
LED used to indicate the status of an output unit.

(27) Input terminal board
Used to connect the cable from input unit.

(28) Output terminal board
Used to connect the cable from output unit.

(29) Terminal ID label

(30) Rating plate

(31) Supporting screw hole
Used to support of the controller and expansion power supply unit, or, for connection of other I/O units using the joint metal.

(32) Supporting hole
Used for installation of I/O units to the controller with screw in use.

(33) 24 VDC power supply spring pin (IO-1102, IO-1102, IO-1106, IO-1107 only)
Used to supply relay coil driving 24 VDC source.

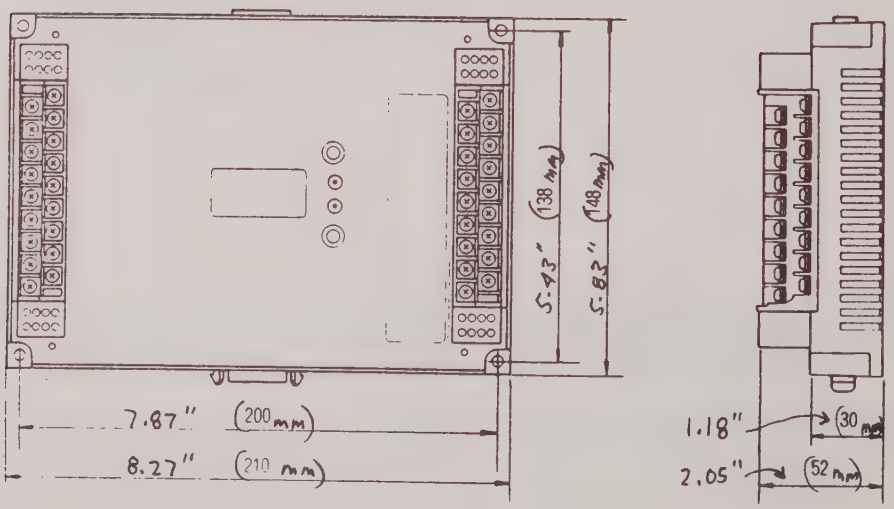
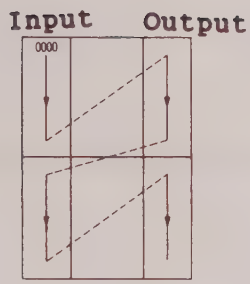


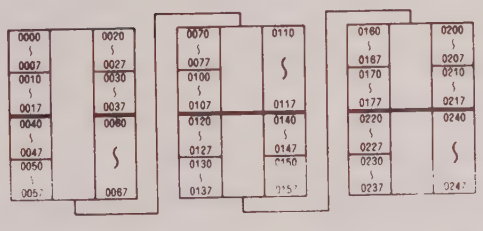
Fig. 5, Physical Dimensions (mm)

I/O NUMBERING

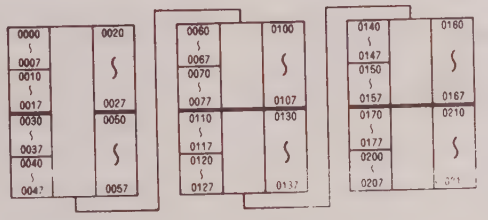
The relay numbers of the I/O units must be assigned a sequential number from the input side to the output side.



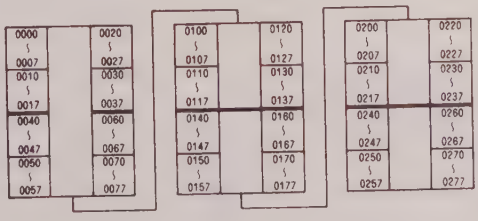
(1) When only 32-point I/O units are used their locations vs. relay numbers will be as shown on opposite:



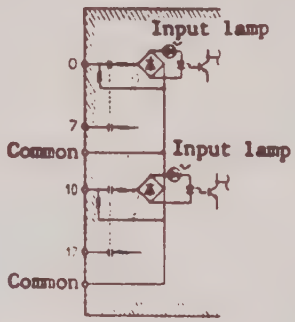
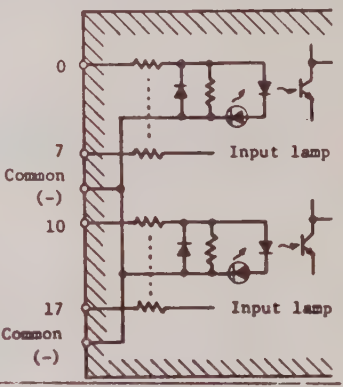
(2) When only 24-point I/O units are used, their locations vs. relay numbers will be as shown on opposite:



(3) When 32-point I/O units are used with 24-point I/O units, for example, their locations vs. relay numbers will be as shown on opposite:



Input specification

Type		AC input	DC input
Part Number		IO-1100/1105 1101/1106	IO-1103/1108 1104/1109 1102/1107
Circuit configuration			
Isolation method		Opto-isolated	Opto-isolated
Number of inputs		16 points	16 points
Rated input voltage		110/120 VAC, 50/60 Hz with less than 5% of waveform distortion	24 VDC (ripple, 10% max)
		Photo electric and proximity switches may not allow the inputs to go OFF if their signal level is not low enough, or does not transition fast enough.	
Input voltage range		0 to 132 VAC	0 to 32 VDC
Input voltage level	ON level	80 V or higher	14 V or lower
	OFF level	30 V or higher	6 V or higher
Input current level	ON level	9.5 mA or less	5.8 mA or less
	OFF level	3.0 mA or more	2 mA or more
Input impedance		About 10 Kohms (50 Hz)	About 2.4 Kohms
Response time	OFF to ON	15 ms, max (120 VAC)	12 ms, max (24 VDC)
	ON to OFF	30 ms, max (120 VAC)	12 ms, max (24 VDC)
Internal power comsumption (5 VDC)		155 mA, max	130 mA, max

SPECIAL NOTE

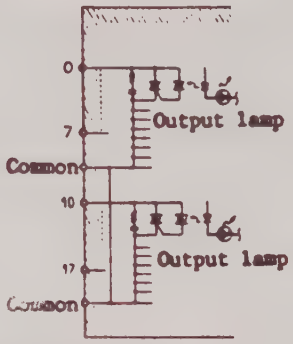
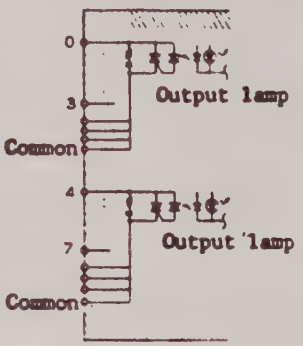
All DC Input modules must have the hot wire connected to the COMMON lead(s) of the modules, not the ground wire.

	AC input	DC input
Status indication	LED lights up when the unit is active	LED lights up when the unit is active.
Connection terminal	18 pin terminal board (16 points and 2 commons) 1 common per 8 points	
Operating temperature	32°F to 130°F to (0 to 55°C)	
Operating humidity	35 to 90% RH, without moisture condensation.	
Insulation resistance	More than 10 Mohms between the input terminal and the secondary circuit as measured on the 500 VDC meg ohm meter.	
Dielectric strength	1500 VDC for one minute between the input terminal and the secondary circuit.	

NOTE-1:

The AC input status indicator is located on the secondary circuit side for the IO-1106.

Output specification

	TRIAC OUTPUT	
Part Number	IO-1100/1104	IO-1105/1109
Circuit configuration		
Isolation method	Opto-isolated	Opto-isolated
Number of inputs	16 points	8 points
Rated input voltage	110/120 VAC, 50/60 Hz with less than 5% of waveform distortion	110/120, 220/240 VAC, 50/60 Hz, with less than 5% of waveform distortion
Output voltage range	15 to 132 VAC	15 to 250 VAC
Maximum allowable output current	1 A (AC)/point (See NOTE-2) Less than 5 A per group of 8 points	2 A (AC)/point (See NOTE-3) Less than 5 A per group of 4 points
Surge on current	Output element characteristics: 80A (one cycle)	Output element characteristics: 80A (one cycle)
Leakage current	2 mA, max., (sine wave)	3 mA, max., (sine wave)
	The outputs may not go off because of leakage current. When a neon lamp or light load relay is used.	
On voltage	2V, max., 1A	2V, max., 2A

		TRIAC output	
Response time	OFF to ON	1 ms, max.	1 ms, max.
	ON to OFF	10 ms, max.	10 ms, max.
Internal power consumption (5 VAC)		272 mA, max.	152 mA, max.
Status indication		LED lights up when the unit is active.	LED lights up whem the unit is active.
Connection terminal		18 pin terminal board (16 points and 2 commons) 1 common per 8 points (common shared)	18 pin terminal board (8 points 8 commons, 2 opens) (4 commons shared) (See NOTE-4)
Operating temperature		32°F to 130°F (0 to 55°C)	
Operating humidity		35 to 90% RH, without moisture condensation.	
Insulation resistance		More than 10 Mohms between the output terminal and the secondary circuit as measured on 500 VDC meg ohm meter.	
Dielectric strength		1500 VDC for one minute between the output terminal and the secondary circuit.	

NOTE-2:

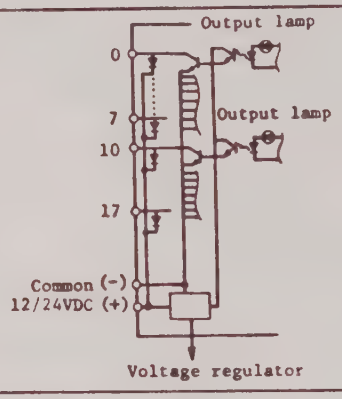
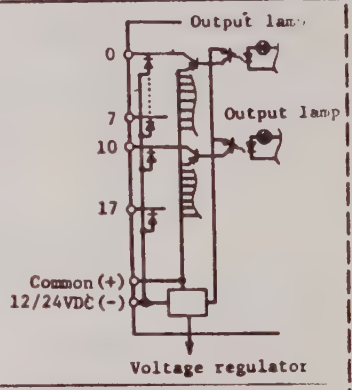
The current is limited by handling eight output address numbers (0 through 7) as one group, and eight output address numbers (10 through 17) as one group. If the operating temperature is above 45°C, the current is limited to 4 amps per group of eight outputs.

NOTE-3:

The current is limited by handling four output address numbers (0 through 3) as one group, and four output address numbers (4 through 7) as one group. If the operating temperature is above 45°C, the current is limited to 4 amps per group of four outputs.

NOTE-4:

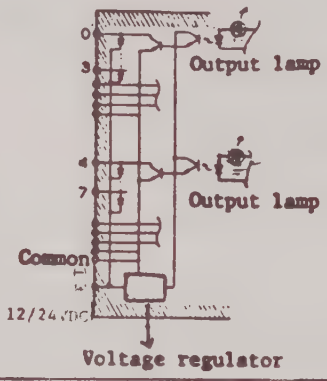
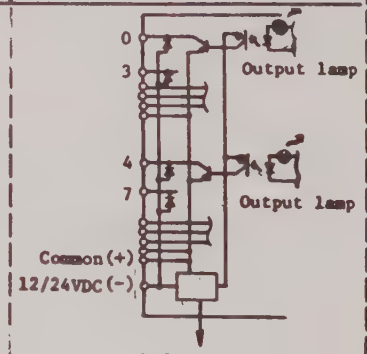
There are two separate groups of four shared outputs, but each output has an independent common terminal.

		Transistor output	
Part Number		IO-1103	IO-1103
Circuit configuration			
Isolation method		Opto-isolated	Opto-isolated
Number of outputs		16 points	8 points
Rated output voltage		12/24 VDC	12/24 VDC
Output voltage range		10 to 30 VDC	10 to 30 VDC
Maximum allowable output current		0.5 A (DC)/point Less than 4 A per group of 8 points	2 A (DC)/point (See NOTE-5) Less than 4 A per group of 4 points
Surge on current		Output element characteristics: 8 A (10 ms, max)	Output element characteristics: 8 A (10 ms, max)
Leakage current		0.1 mA max	0.1 mA, max
On voltage		2 V, max., 0.5 A	2 V, max., 0.5 A
Response time	OFF to ON	1 ms, max (resistive load)	1 ms, max (resistive load)
	ON to OFF	1 ms, max (resistive load)	1 ms, max (resistive load)
		If a large inductive load is used, the ON to OFF response time may take up to one second.	
Internal power comsumption (5 VDC)		80 mA, max	80 mA, max

	Transistor output	
Status indication	LED lights up when the unit is active	LED lights up when the unit is active.
Connection terminal	18 pin terminal board (16 points, 1 power supply, and 1 common	18 pin terminal board (16 points, 1 power supply, and 1 common)
Operating temperature	0 to 55°C	
Operating humidity	35 to 90% RH, without moisture condensation.	
Insulation resistance	More than 10 Mohms between the output terminal and the secondary circuit as measured on 500 VDC meg ohm meter.	
Dielectric strength	1500 VDC for one minute between the output terminal and the secondary circuit.	

NOTE-5:

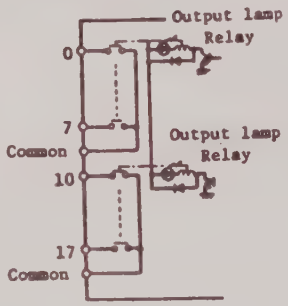
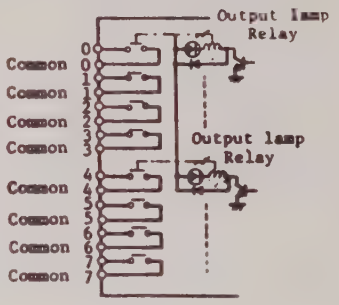
The current is limited by handling four output address numbers (0 through 3) as one group, and four outputs address numbers (4 through 7) as one group.

		Transistor output	
Part Number		IO-1108	IO-1108
Circuit configuration			
Isolation method		Opto-isolated	Opto-isolated
Number of outputs		8 points	8 points
Rated output voltage		12/24 VDC	12/24 VDC
Output voltage range		10 to 30 VDC	10 to 30 VDC
Maximum allowable output current		2A (DC)/point (See NOTE-4a) Less than 4 A per group of 4 points	
Surge on current		Output element characteristics: 8 A (10 ms, max)	Output element characteristics: 8 A (10 ms, max)
Leakage current		0.1 mA max	0.1 mA, max
On voltage		2 V, max., 2 A	2 V, max., 2 A
Response time	OFF to ON	1 ms, max (resistive load)	1 ms, max (resistive load)
	ON to OFF	1 ms, max (resistive load)	1 ms, max (resistive load)
		If a large inductive load is used, the ON to OFF response time may take up to one second.	
Internal power comsumption (5 VDC)		48 mA, max	48 mA, max

	Transistor output	
Status indication	LED lights up when the unit is active	LED lights up when the unit is active.
Connection terminal	18 pin terminal board (8 points, 1 power supply, and 9 common)	
Operating temperature	32° to 130°F (0 to 55°C)	
Operating humidity	35 to 90% RH, non-condensing	
Insulation resistance	More than 10M ohms between the output terminal and the secondary circuit as measured on 500 VDC meg ohm meter.	
Dielectric strength	1500 VDC for one minute between the output terminal and the secondary circuit.	

NOTE-4a:

The current is limited by handling four output address numbers (0 through 3) as one group, and four outputs address numbers (4 through 7) as one group.

	Relay output	
Unit name	IO-1102/1101	IO-1107/1106
Circuit configuration		
Isolation method	Relay isolation	Relay isolation
Number of outputs	16 points	8 points
Maximum allowable ON/OFF voltage current	250 VAC/30 VDC, 2 A, resistance load Less than 8 A per group of 8 points (See NOTE-6)	250 VAC/30 VDC, 2 A, resistance load Less than 8 A per group of 4 points
Minimum load	5 V, 1 mA	5 V, 1 mA
Life	Mechanical life: More than 10 million Electrical life: More than 100 thousand under maximum allowable ON/OFF voltage current load More than 100 thousand under 240 VAC at 0.5 A	
Leakage current	None	None
Response time OFF to ON	15 ms, max.	15 ms, max.
Response time ON to OFF	15 ms, max.	15 max. max.
Internal power consumption (5 VDC)	30 mA, max.	20 mA, max.
External power supply capacity	24 to 30 VDC, 17 mA per ON points	

	Relay output	
Status indication	LED lights up when the unit is active	LED lights up when the unit is active.
Connection terminal	18 pin terminal board (16 points and 2 commons) (Inpedendent common)	18 pin terminal board (8 points, 8 commons, 2 opens) (Independent common)
Operating temperature	32°F to 130°F (0 to 55°C)	
Operating humidity	35 to 90% RH, non-condensing	
Insulation resistance	More than 10 Mohms between the output terminal and the secondary circuit as measured with 500 VDC meg ohm meter.	
Dielectric strength	1500 VDC for one minute between the output terminal and the secondary circuit.	

NOTE-6:

The current is limited by handling eight output address numbers (0 through 7) as one group, and eight output address numbers (10 through 17) as one group.

CHAPTER 4 - SCAN AND I/O CONSIDERATIONS

Scan Time

The machine goes into the scanning routine upon completion of the power-up procedure. The scan cycle begins with a hardware check to the end of your program (the F-40 END instruction). When the program execution has been complete, the control returns to the hardware check and begins to solve the user logic again. The time required to execute this one cycle is called the scan time.

(1) Hardware checks
Self-diagnostics are carried out to be sure the controller's hardware is properly working.

a. ROM Test
Examines the CRC code for the ROM on the CPU board. The ROM contains the microprogram with which the CPU performs its internal processing. The ROM check is done only for the cycle immediately after power up.

b. RAM Test
The data memory RAM is tested to be sure it is capable of being written to and read from.

c. Hardware Operational Tests
The bit processing (AND, OR operation, etc.) accumulator and stacks are checked for proper function.

d. Parity Check-Functional Operations Test
The parity check is carried out for the program memory when it executes an instruction. The parity check ensures that the hardware is working properly.

e. I/O Data Bus Test
Normally, the I/O data bus (which exchanges data between the CPU and I/O units) is in the idle state during the hardware test. If it is not in the idle state, it will be seen as an I/O data bus error.

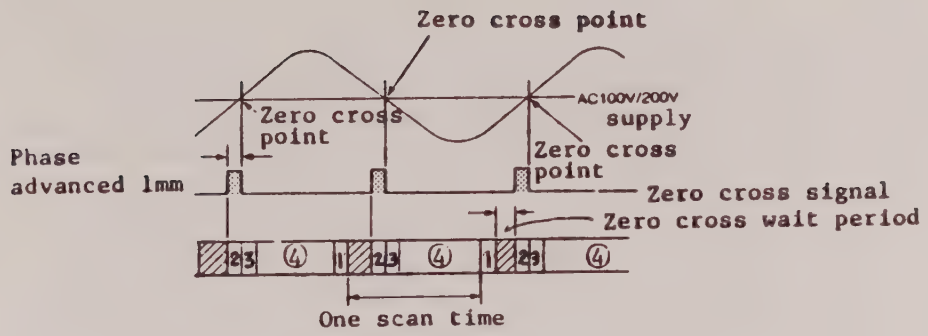
NOTE-1: The following five items are tested by the self-diagnostics:
1. I/O signal tests
2. Watchdog timer
3. Parity check
4. Power supply failure
5. Option failure
6. Battery failure

(2) Clearing Of Flags

Some data processing instructions affect the flags according to an operational result. The flags are cleared before the user program is executed at the begining of the scan.

(3) Zero Cross Synchronization

Zero cross synchronization is done near the zero cross point of the AC supply. The I/O execution is carried out at the zero cross point when using the 100VAC or 200VAC output unit. This helps to prevent power surges and damage to solenoids when changing their state. When the contents of data memory are written to the outputs by the I/O execution, the output turns ON or OFF accordingly.



① Hardware check
② I/O processing
③ Option processing, etc.
④ User program execution

Fig. 6, Zero Cross Point Illustration

NOTE-1: If the total execution time for I/O processing, option processing, user program processing and hardware test (one scan) should not be completed within half of a power supply cycle, the scan time would be extended considerably as illustrated below:

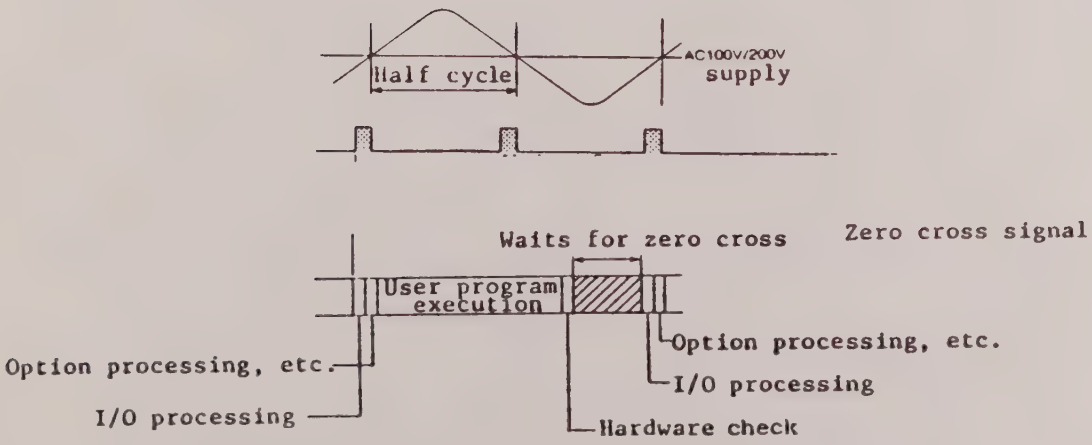


Fig. 7, Program Execution Longer Than Half-Cycle.

DC output units do not require the use of the zero cross synchronization. The zero cross wait time can be set to zero by programming the data memory zero cross switch 7367 to ON.

7366 is Ever-OFF contact and 7367 is Ever-ON.

The following examples show two cases where the zero cross is used and not used, provided that solenoid A turns from ON to OFF and the solenoid B from OFF to ON at the same time. As it shortened by the simultaneous ON time, it prevents the solenoid from burning.

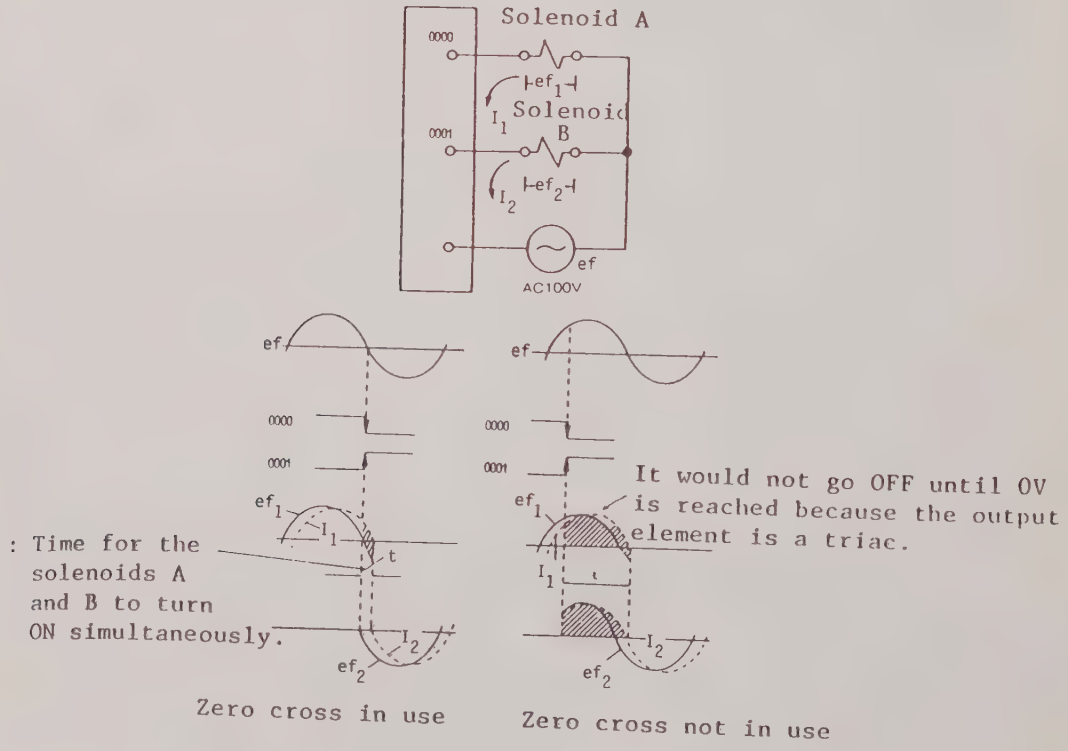


Fig. 8, Examples of Zero Cross Utilization.

(4) I/O processing

Data is exchanged between the I/O units and the data memory area. Execution starts from the I/O unit having the lowest I/O relay number, then next lowest, etc.

a. I/O signal error check

The I/O unit will issue the "I/O signal" which informs the CPU whether it is the input unit or output unit. Then, the CPU executes the input processing (data from the input unit transferred to the data memory) or the output processing (the contents of the data memory transferred to the output unit), depending on this "I/O signal". If there is a unit that issues this "I/O signal" before selection of the I/O unit, it will be seen as an I/O signal failure.
This test is carried out once per 8 points. In the case of a 16-point unit, the test is done twice; before selection of a first 8 points and before selection of the next 8 points.

b. I/O unit processing

When the selected unit is an input unit, the ON/OFF state of the input device connected to the input unit (such as a limit switch) is written into the data memory address corresponding to the input unit.
When the selected unit is an output unit, the contents of the data memory stored in the address corresponding to the output unit are latched into the output unit so that the output unit changes to ON or OFF.

NOTE-1: In the first cycle after power up, the contents of the data memory initialized by the power-up procedure are written in the output unit. In the following scans, the operational result for that output unit is written into the output unit.

NOTE-2: If the "I/O signal" does not return from the I/O unit, the CPU assumes that the unit is not connected. The controller then terminates the I/O processing and begins the watchdog timer reset. The timer's duration may vary depending on the number of I/O units connected.

NOTE-3: Sections where the input unit is connected, but has no input devices, will be seen as OFF during I/O processing. It cannot be used for auxiliary relays.

NOTE-4: Sections where the output unit is connected, but has no output device, can be used for auxiliary relays. The contents of the data memory are written into the output unit during the I/O processing and the LED lights up on the output unit.

NOTE-5: When the I/O and auxiliary relay areas are used in a program but no output module is installed for the

corresponding address, a great deal of program revision (moving the auxiliary relay to other areas) may be required in order to use an I/O device in this area in the future. Program documentation should note this detail.

(5) Watchdog timer

The watchdog timer checks the hardware to be sure the CPU is operating correctly. When the CPU resets the watchdog timer each scan cycle is executed normally. When there's an error in the scan time, a time up signal is applied to the watchdog timer (the CPU does not reset the watchdog timer). The HALT output then turns OFF. This turns the RUN indicator OFF and turns the ERROR indicator ON on the operation panel.

(6) Processing as requested from the programmer.

The I/O accepts monitor and preset value changes from the PP-0110 Programmer. When a memory request is sent to the controller unit from the programmer, the control unit goes into a hold state and deactivates the bus line. The watchdog timer is then reset, avoiding a time out.

(7) Set and reset of the 0.1-second clock (7360) and 1-second clock (7364)

The state of the 0.1-second clock is set in latched relay 7360. The state of the 1-second clock is set in latched relay 7364.

(8) User program processing

a. User program parity check
One word of the user program consists of two bytes. When the program is entered, parity is generated and added to each word. During execution of the user program, the parity is examined as each word of the program is read. When a parity error is encountered, the controller will process the parity error.

NOTE

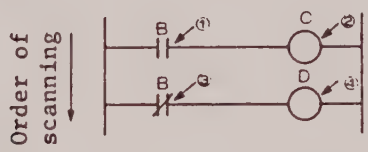
The PC 0185 uses the self-checks to detect I/O data has shorts and I/O signal premature responses. An I/O module and/or I/O cable may be removed and/or replaced without causing an I/O self-diagnostic failure, and the PC continues operating.

b. User program execution

As long as a parity error is not found, the controller continues to process the contents of the user program. The STR, STR NOT, AND, AND NOT, OR, OR NOT, AND STR, and OR STR, operations store the result in the accumulator and stack registers.
The OUT, TMR, CNT, MD, and most of the application instructions (F-xx) are stored in the data memory. Prior to the execution of the user program, the ON/OFF states of the inputs are batch transferrad to the data memory. Batch transferral of input dates prior to the execution of instructions eliminates input racing conditions as described in reference below. The contents of the data memory are then referred to in executing the user's program.

REFERENCE: Input Racing may occur with a PC reading the input's ON/OFF state each time an instruction is executed.

(Example)

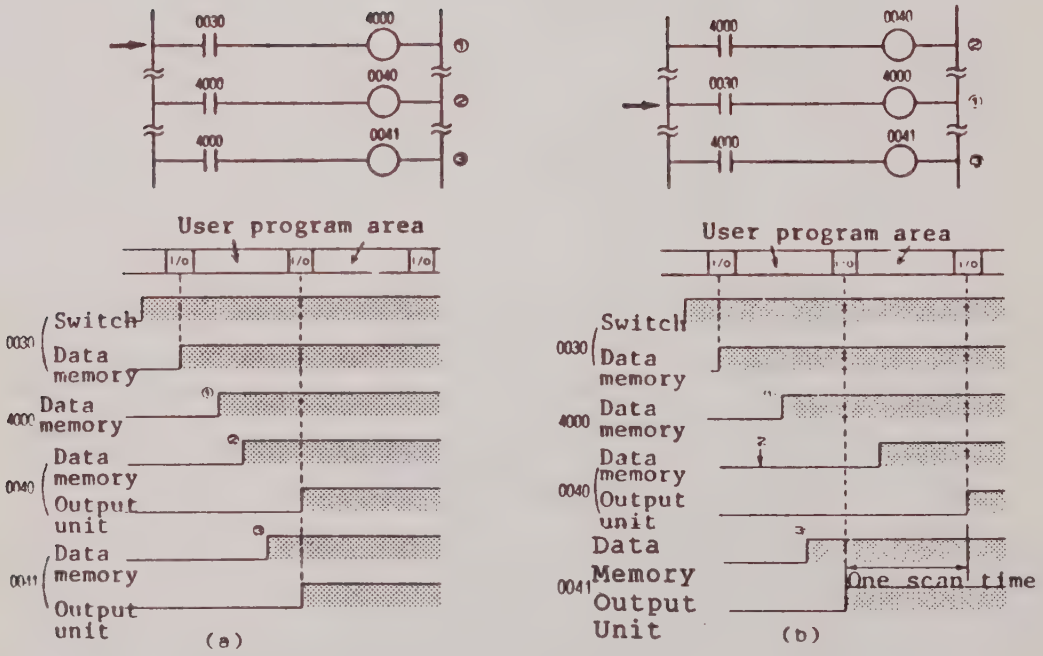


(The program sets coil C ON when input B is ON and coil D is set ON; when input B is OFF.)

In the above program "C=D". Assume that B is ON (C being ON) when the state of input B is set from the input unit to the accumulator at the 1st scan. But, if the state of input B changes to OFF before the operation of 3, B is seen as OFF during the operation of 3. This causes the coil D to turn ON, which results in illogical condition (both C and D are ON). Because this condition is not stable, it may lead to a malfunction.

With instructions that store the operational result in the data memory (like the OUT instruction), the result is stored each time it is executed. However, the state of the output unit does not change until the output is processed on the next scan cycle. When an instruction that stores the operational result in the data memory (like the OUT instruction) is followed by an instruction which uses respective data memory as contact, the operation takes place on the basis of the contents that were revised by the OUT instruction.

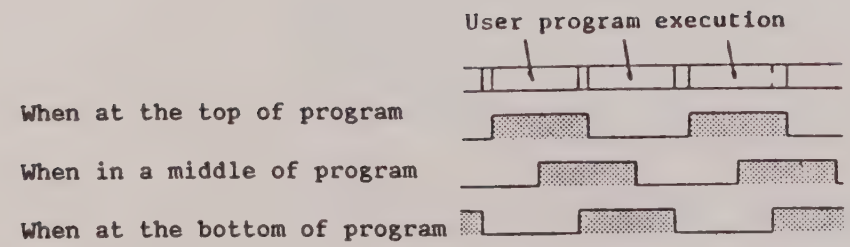
(Ex-1)



Program Data Manipulation Example

If the program write sequence is changed as in (a) and (b), it may produce a different result. There would be no difference between (a) and (b) with the relay board for parallel operation. But, with the sequence controller which performs serial operation (almost all currently available sequence controllers are this type), the above mentioned phenomenon may appear. Thus, attention must be given to the following point in using the auxiliary contact of the coil.
The change in state of the aux contact is written before the change of the coil's state is recognized on the next scan.

The figure "Change of State for Auxiliary Contact", on the other hand, uses the theory "change of state in the auxiliary contact written before the coil takes place at a next scan that the state of the coil changed". ON/OFF is repeated at every scan cycle (oscillation circuit). This pulse may be used for the basic clock of flashing circuit or operation start signal at every other single scan. As shown in the timing chart, the ON/OFF timing may vary depending on the location of the oscillation circuit program on the user program. Care must be taken in using this pulse for an operation start signal.



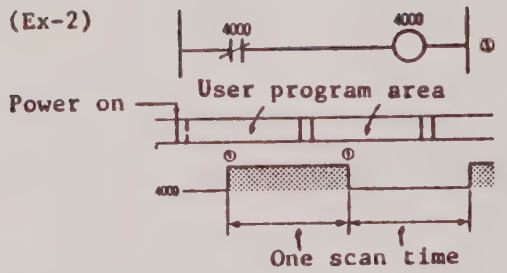


Fig. 9, Change of State for Auxiliary Contact

When the user program uses the same relay number repeatedly for the same coil, the last state of the coil is left in the data memory at the end of the program. It is then written to the output unit during I/O processing during the next scan cycle.

(9) Scan time

The time required to complete everything from the hardware test to the execution of the F-40 END instruction is called the scan time. The approximate time can be obtained by using the equation shown below. The time required for the execution of a request from the programmer is not included in the scan time, because it varies depending on existing requests and the contents of processing. The time required for the hardware test, writing the 0.1-second and 1-second clocks to latched relays, or reseting the flags can be disregarded because they are relatively short when as compared with other processing times.

1 scan time (T) = I/O processing time (t_1) + user program processing time (t_2)

a. I/O processing time (t_1):
This is the time required for the CPU to read the input units and write to the output units. The I/O processing time can be determined by the number of input and output units in the base unit.

t_1 = number of input units x t (in) + number of output unit x t(out)

	For 16-point unit	For 32-point unit
t(in)	34.72 (us)	64.44 (us)
t(out)	39.06 (us)	78.12 (us)

(Ex)

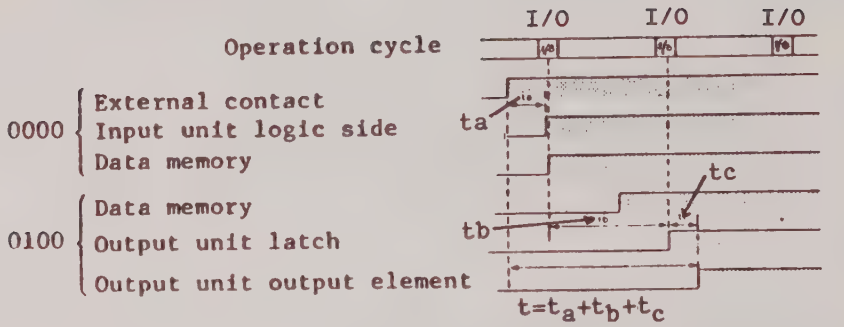
16-point input unit	4 units
32-point input unit	1 units
16-point output unit	9 units
32-point output unit	2 units

t_1=34.72 x 4 + 69.44 x 1 + 39.06 x 9 + 78.12 x 2 + 716.1 (us)

b. User program execution time (t_2):
This is the total time required for execution of all instructions from the program address 00000 to the END instruction.

NOTE-1: The execution time of the application instructions may vary depending on their inputs, preset values, and placement within the program.

(a) When shortest



ta ... Input unit OFF to ON response time
tb ... One scan time
tc ... Output unit OFF to ON response time

(b) When longest

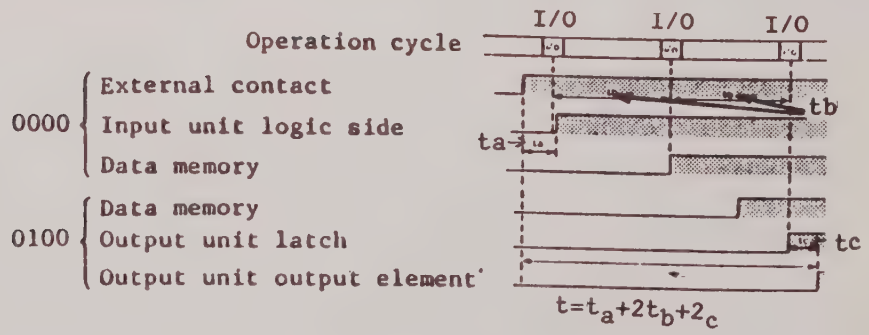


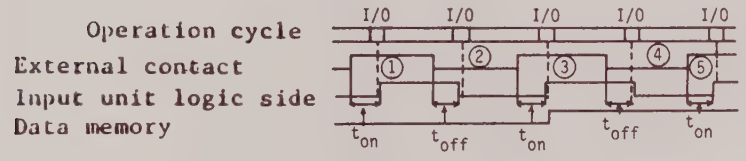
Fig. 10, Response Time Illustration

c. END instruction

When the program memory is cleared, the entire program memory area is filled with NOP instructions and the F-40 (END instruction) is written into the last program address. If the F-40 instruction is written into the address immediately after the program step, the scan time will be as short as possible.

The figure "Zero Cross Synchronization" shows the overall PC response time, and includes the I/O unit's response time. It shows the time required until the output element of the output unit (transistor, triac, or relay) changes after a change has occured in contact 0000. A change from ON to OFF, may show a delay in the response time of the input and output units.

NOTE-3: In order to set the ON/OFF state of the contact into the data memory, more than one scan is required for the ON or OFF time of the input logic side.



tON .... Input unit OFF to ON response time
tOFF ... Input unit ON to OFF response time

For the external contact in the ON state at 1, the data memory remains OFF as the input unit logic side was OFF immediately before the I/O process at "b" and the I/O process of the respective input had been terminated when the input unit logic side was turned ON.

For the external contact in the ON state at 3, the data memory is written with on as the input unit logic side was ON immediately before the I/O process at "C".

For the external contact in the OFF state at 4, the data memory stays ON as the input unit logic side was still ON during I/O process at "d". In the I/O process at "e", the data memory keeps ON as the input unit is again ON.

If the ON/OFF time on the input unit logic side were shorter than one scan cycle, it may or may not be read into the data memory.

Zero Cross Synchronizations

When using the zero cross synchronization, the scan time is determined by the power supply frequency.

$T = t_1 + t_2$	50Hz	60Hz
When less than a half power supply cycle	10ms	About 8.3ms
When less than one power supply cycle	20ms	About 16.7ms

NOTE-4: When a triac output unit is used, the output triac turns from ON to OFF at the zero cross point of the power supply.

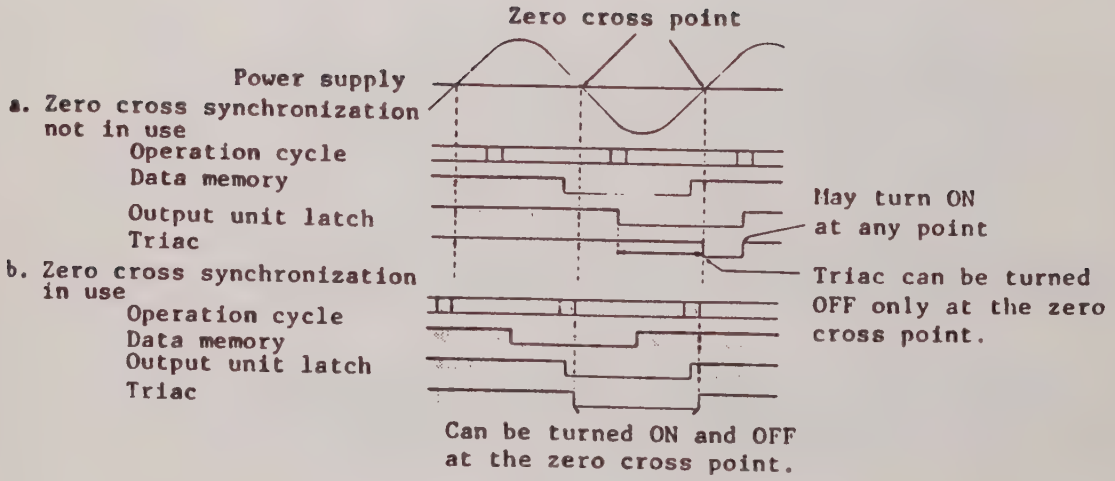

Zero cross point
Power supply
a. Zero cross synchronization not in use
Operation cycle
Data memory
Output unit latch
Triac
May turn ON at any point
b. Zero cross synchronization in use
Operation cycle
Data memory
Output unit latch
Triac
Triac can be turned OFF only at the zero cross point.
Can be turned ON and OFF at the zero cross point.

Fig. 11, Zero Cross Synchronization

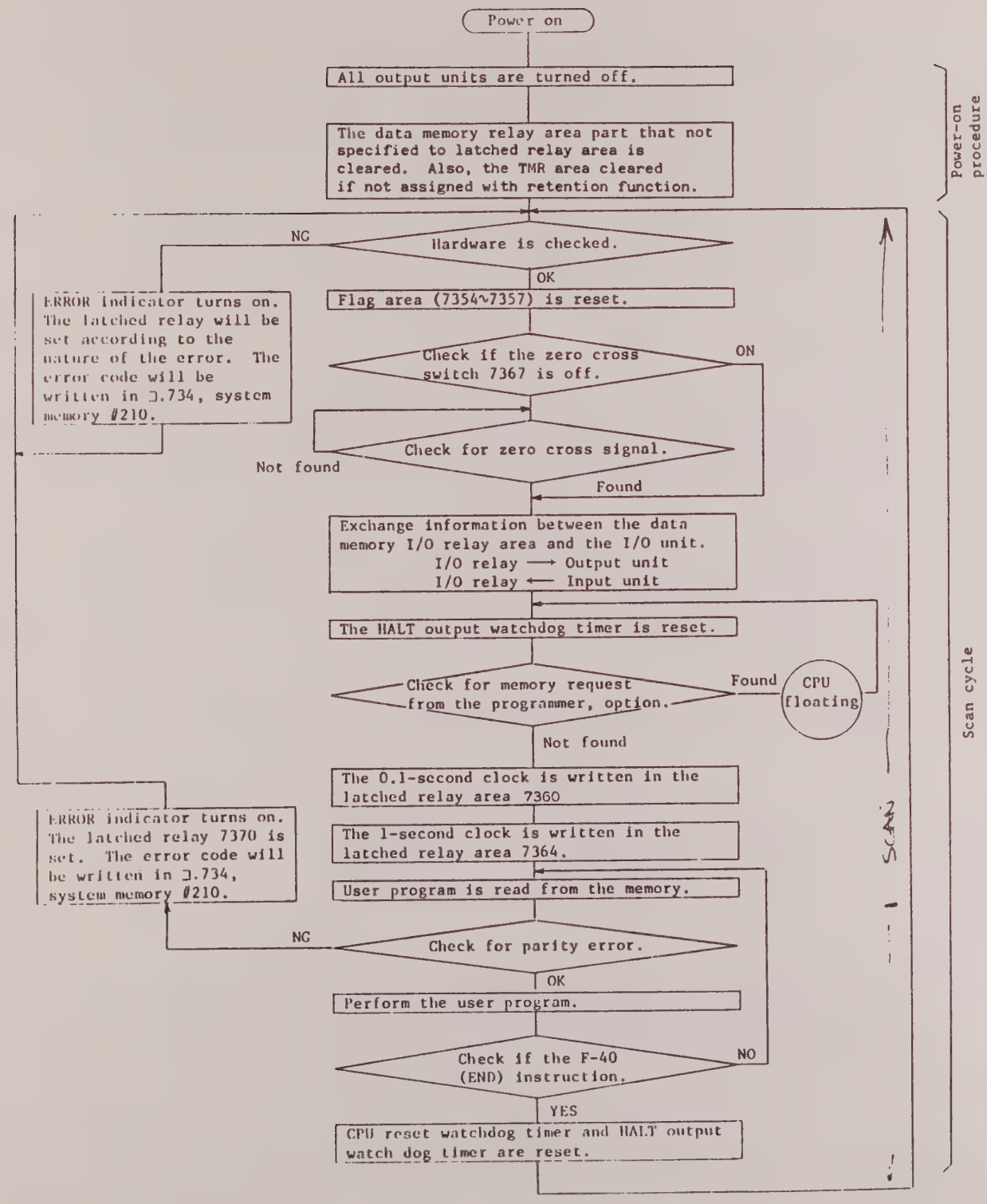

Power on
All output units are turned off.
The data memory relay area part that not specified to latched relay area is cleared. Also, the TMR area cleared if not assigned with retention function.
Power-on procedure
NG
Hardware is checked.
OK
ERROR indicator turns on. The latched relay will be set according to the nature of the error. The error code will be written in ∃.734, system memory #210.
Flag area (7354~7357) is reset.
Check if the zero cross switch 7367 is off.
ON
Check for zero cross signal.
Not found
Found
Exchange information between the data memory I/O relay area and the I/O unit.
I/O relay ⟶ Output unit
I/O relay ⟵ Input unit
The HALT output watchdog timer is reset.
Check for memory request from the programmer, option.
Found
CPU floating
Not found
The 0.1-second clock is written in the latched relay area 7360
ERROR indicator turns on. The latched relay 7370 is set. The error code will be written in ∃.734, system memory #210.
The 1-second clock is written in the latched relay area 7364.
User program is read from the memory.
NG
Check for parity error.
OK
Perform the user program.
Check if the F-40 (END) instruction.
NO
YES
CPU reset watchdog timer and HALT output watch dog timer are reset.
SCAN
Scan cycle

Fig. 12, Operational Flowchart

Engineering Notes for I/O Units

1) Number of I/O points

The maximum number of I/O points for the PC0185 are 96 input and 96 outputs. This permits six I/O units to to be connected to one controller. However, the number of inputs and outputs may be restricted by the power supply's capacity.

2) Input signal ON/OFF time

To gather the data needed to solve a user program, the input states are sensed and written to the data memory at the beginning of each scan. If the inputs change state (OFF to ON or ON to OFF) faster than the scan time, some state changes will be missed. In order to positively reflect the ON/OFF state of the input devices (such as limit switches):

The input device's ON time must be greater than the total of one scan time plus the OFF to ON response of the input module. The input device's OFF time must be greater than the total of one scan time plus the ON to OFF response time of the input module.

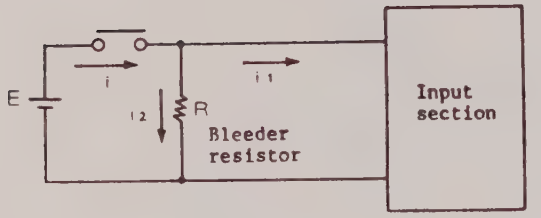
Example: (Assume that you have an AC input unit and a scan time of 5 mSec)

Scan Time		Response Time		Input device's ON time
5	+	15	=	20 (mSec)
5	+	30	=	35 (mSec)

The response time of the input modules depends on the charge/discharge characteristics of the input modules. Therefore, the time allowed for state charges (ON to OFF or OFF to ON) will vary.

3) Bleeder resistor

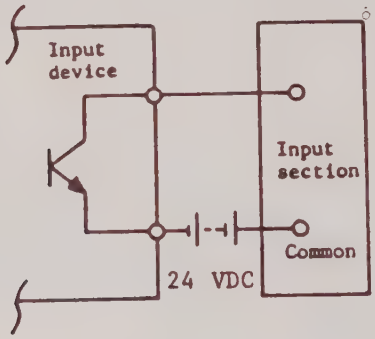
Only a certain amount of current can flow through the contact point of an input device (about 10 mA when 24VDC is added to the IO-1103 module). If the current is too high for the contact, install an external bleeder resistor.



$$I = i_1 + i_2 = i_1 + \frac{E}{R}$$

Where watt is: $P > \frac{E^2}{R} \times 2$

4) To connect a transistor output device to the DC input unit, choose an open collector output to use with the input device as (contactless relays, photoelectric switches, proximity switches).

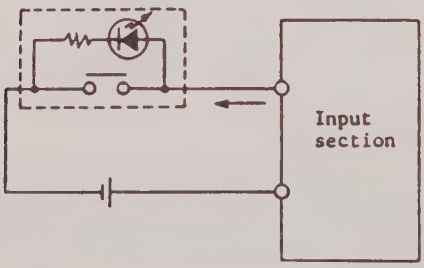


NOTE:

Make sure that the power rating of the transistor can handle the input supply voltage and input current.

5) Input device current

(a) Limit switch with LED



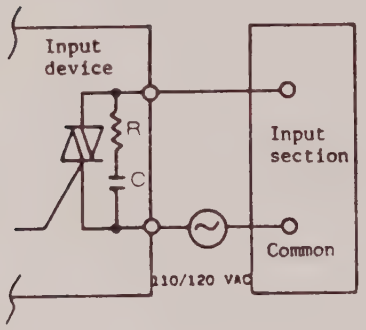
If the LED's drive currentis too low, the input section may not go OFF; even if the limit switch is OFF.

(b) Proximity switch, photelectric switch
Consumption current flows through the detect circuit even while these devices are OFF (AC, 2-wire, types). Therefore, the input module may not turn OFF. For "leakage current" (photoelectric switches), make sure that the value is below the OFF level of the input module.

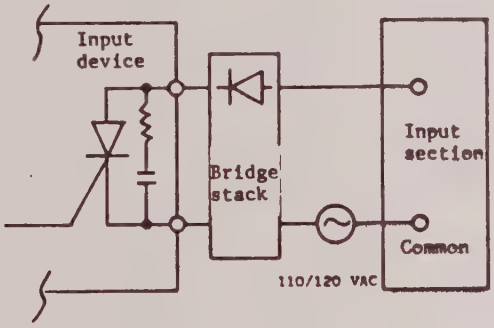
6) Input devices with triac or thyristor output circuits:

Since some devices contain an RC network as surge suppression (to prevent arcing of the triac or thyristor), the leakage current in the RC network may delay the recognition of the input device's OFF condition. Though it is preferable to remove the RC network, the value of C should be less than 0.03 uF at 110/120 VAC if it is not possible to remove it.

Tr ac output example



Thyristor output example



7) Maximum voltage and current switched at the output module:
Within the given rating, every output module is capable of directly driving output devices (solenoid valves, magnetic switches, etc).

Part Number	Rated voltage	Maximum voltage	Rated maximum current	Surge ON current
IO-1100 1104	110/120 VAC	132 VAC	1 A	80 A (1 cycle)
1105 1109	110/120/200/ 240 VAC	250 VAC	2 A	80 A (1 cycle)
1103	12/24 VDC	30 VDC	0.5 A	1 A (10 ms, max)
1108	12/24 VDC	30 VDC	2 A	8 A (10 ms, max)
1102		250 VAC	2 A	
1101		30 VDC	2 A	
1107		250 VAC	2 A	
1106		30 VDC	2 A	

NOTE-1:

Surge ON current, represents the output element characteristics.

If several devices were to be ON at the same time within a group using the same common, the total current should be less the value shwon in the table below. For a group of 8 points, the output address numbers 0 through 7 constitute one group and 10 through 17 another group. Where one group consists of four points, the address numbers 0 through 3 constitute one group and 4 through 7 another group.

Part No.	Outputs per group	Maximum output current
IO-0100 0104	8 points	5 A, maximum
0105 0109	4 points	5 A, maximum
0103	8 points	4 A, maximum
0108	4 points	4 A, maximum
0102 0101	8 points	8 A, maximum (See NOTE-2)
0107 0106	4 points	8 A, maximum (See NOTE-2)

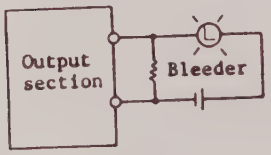
NOTE-2:

These rating are for resistive loads. Consider the power factor for inductive loads such as solenoid valves and magnetic switches.

8) Lamp Load and Instantaneous Current

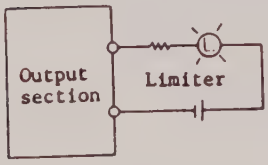
For incandescent lamp loads, an instantaneous current of 10 to 20 times the normal current will exsist for a period of about 10 milliseconds. There are two ways to reduce this current: inserting a bleeder resistor or a current limiting resistor.

(a) Bleeder resistor



A small amount of current (that does not activate the lamp) should be applied during the OFF time of the output module.

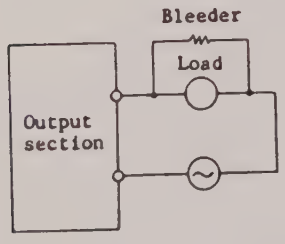
(b) Current limiting resistor



The resistor value should be determined on the basis of the brightness required when the lamp is ON.

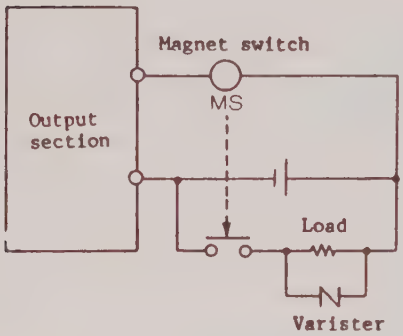
9) Triac Output Unit Leakage Current

A leakage current of less than 2 mA flows during the OFF time of the triac output units (IO-1100, 1104, 1105, 1109). To reduce the possibility that the load does not go OFF because of this leakage current, a bleeder resistor should be inserted in parallel to the load.



The value of resistor must be calculated on the basis of the load used. (About 10K ohms and 5 watts for 110/120 VAC or 20 watts for 220/240 VAC).

10) To drive a large current inductive load with the transistor output units: (IO-1103 and 1108)
A surge absorbing diode is contained in these units in order to prevent destruction of the output transistor (due to a surge when the units are connected with the load).



Energy accumulated in the coil is consumed in the diode by the resistance of the inductive load as Joule heat when the output turns from ON to OFF. Delay will be met for the restoration time until the energy becomes the load retention force. The delay time is determined by the value of "L", resistor value, and retention force. If this delay time is a problem as a result of actual measurement, a load should be driven via a magnet switch. This makes the value relatively smaller than using a solenoid valve and it improves the response time.

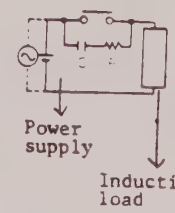
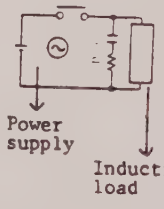
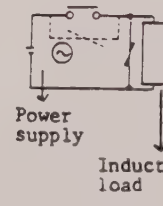
11) Protection Fuse

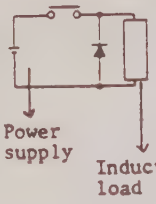
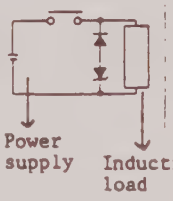
A fuse must be installed to protect printed circuit boards and signal lines from burn-out. One for 16 points of IO-1100, 1103, and 1104; one for 8 points of 1102, 1101, and 1108; one for 4 points of 1105 and 1109, and one for 1 point of 1108 and 1106 units. The fuse will not provide overcurrent protection of the output element or load.

(12) Surge supression means

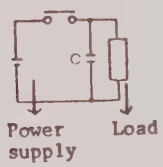
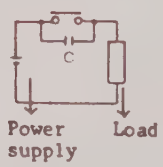
It is possible to generate several thousands volts opening and closing the load; depending on the type of load. Output surge prevention has been included in the IO-1100, 1105, 1103, 1108, 1104, and 1109 units. Specific surge prevention measures may be required with the transistor output types (1103 and 1108) if the signal line to the load is too long. Since the surge prevention has not been incorporated for the relay output units (1102, 1107, 1101, and 1106), you may need to install an external surge supressor. This extends the life of contact points, prevents noise, and reduces generation of carbon by arcing and the formation of nitric acid. However, incorrect use of the arc surpressor may cause adverse effects. Also, it must be noted that the use of the arc surpressor somewhat prolongs restoration times.

Typical arc surpressor examples

Circuit example	Use AC	Use DC	Note	Choice of element
RC network method  Across points			*When operated under AC power, the impedance of the load should be much smaller than the impedance of the RC network. Where the load is a relay or solenoid, there may be a delay in the restoration time. When the source voltage is 24 to 48 volts, it is preferable to make installation across loads. In the case of 100 to 250 volts, installation should be made between contact points. (See diagrams)	The following may be used as approximate values: C: 1 to 0.5 (uF) for contact current of 1A. R: 0.5 to 1 (ohms) for contact voltage of 1 V. The values may not be exact depending on the nature of the load and variation in the relay characteristics. Test to make sure that C performs the discharge suppression during ON and OFF of the contact point; and that R helps to limit current. Use C that has voltage capacity of two to three time of the supply voltage. Use AC capacitor (no polarity).
 Across loads				
Varister  			With this method, voltage is limited by the constant voltage characteristics of the varister. There may be a slight delay in the restoration time. When the source voltage is 24 or 48 volts, it is preferable for more effects to make connection between loads. In the case of 100 to 250 volts, connection should be made between contact points.	

Circuit example	Use AC	Use DC	Note	Choice of element
Diode method 			Energy stored in the coil is released. Heat is dispatched by the resistance of the inductive load. This method involves more delay time than the RC method.	Use a diode whose PIV rating is ten times the circuit voltage, and has a forward current rating larger than the load current. A circuit whose voltage is low, may use a diode having a PIV of two to three times the supply voltage.
Diode + zener diode method 			Method prefered where the normal diode method causes excessive restoration time.	The zener voltage should be the same as the source voltage.

Avoid using the following supression techniques:

 	These circuits supress an arc at shut off, but when the contact point is closed, they are likely to cause the contact point to melt as C is a virtual short circuit.

DC inductive loads are more difficult to switch (without arcing), than DC resistive loads. Using the proper arc supression method can dramatically improve inductive circuit performance.

CHAPTER 5 - Troubleshooting

Preventive Maintenance

The following items should be checked daily for proper operation.

(1) General Site Conditions

Item	Verify	Standards
Ambient temp.	Check if area is within	32 to 140°F°C
Ambient humidity	the range of the	35 to 90%RH
Ambient air	the specifications,	Free of
	Cabinet temp. will be	corrosive gas
Vibration	the ambient temp. when	None
Shock	installed inside cabinet.	None

(2) P.C. Check

Item	Verify	Standards
Control unit ERROR lamp	Visually check the ERROR lamp.	Must be ON
Battery	Check that battery life has not expired.	Must be within the date of expiration date as indicated on label.
Installed condition	Check that the control unit is firmly secured to the I/O unit.	Must be firmly fastened.
	Check that the terminal board screws are tight.	Must be firmly fastened.
	Check that the I/O cable is firmly connected.	Must be firmly connected.

3) I/O Unit Check

Item	Verify	Standards	Notes
Input power supply or output power supply	Check that the supply voltage to I/O units is within the given rating.	• 110/120 VAC input 85-132 VAC	IO-1100 IO-1105 IO-1101 IO-1106
		• 24 VDC input 10-30 VDC	IO-1103 IO-1108 IO-1104 IO-1109 IO-1102 IO-1107
		• 110/120 VAC output 15-132 VAC	IO-1100 IO-1104
		• 110/120/220/240 VAC output 15-242 VAC	IO-1105 IO-1109
		• 12/24 VDC output 10-30 VDC	IO-1103 IO-1108
		• Relay output AC: 0-250 V DC: 0-30 V	IO-1102 IO-1107 IO-1101 IO-1106
Installed I/O	Check that every unit is secured firmly.	Must be firmly fastened.	
	Check that the terminal board screw is firmly fastened.	Must be firmly fastened.	

4) Expansion Power Supply Unit Check

Item	Verify	Standards	Note
Installed condition	Check that the expansion power supply unit is secured firmly.	Must be firmly secured.	
	Check that terminal board screw is firmly fastened.	Must be firmly fastened.	

5) Other Checks

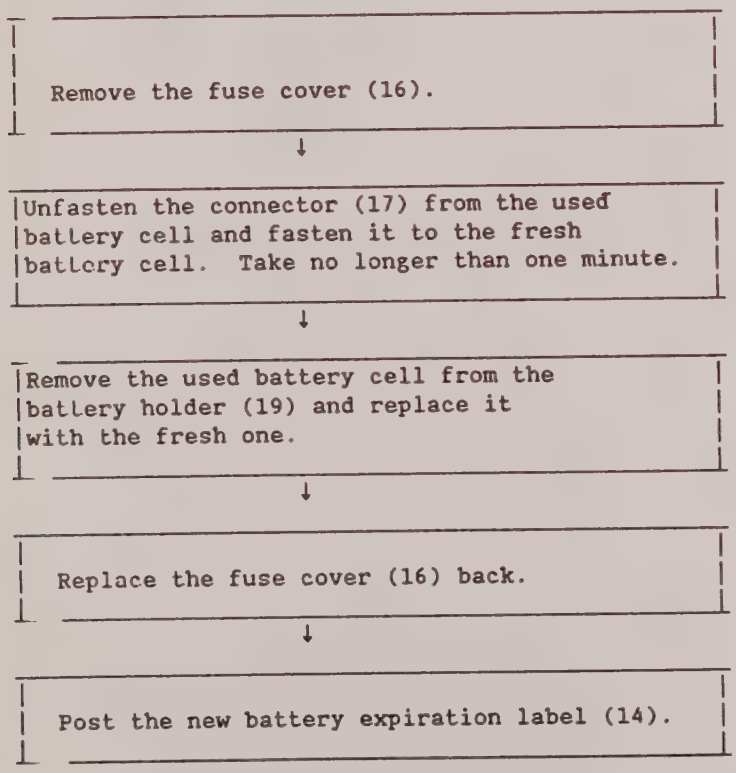
Verify the program on the cassette tape to be sure it does not differ from the program in operation.

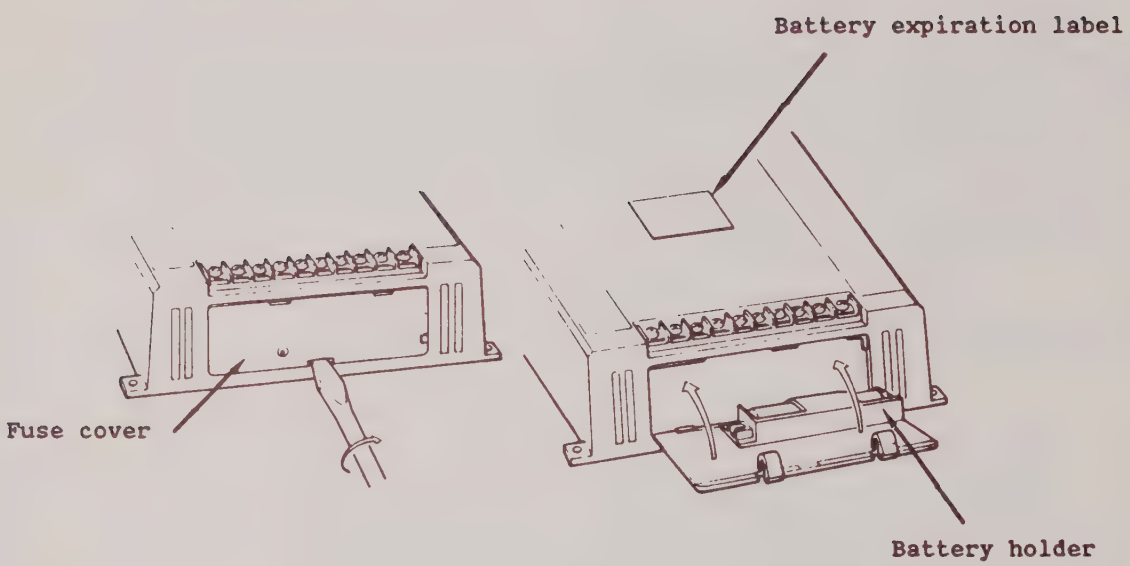
6) Battery Replacement

The memory backup battery cell used for this unit must be replaced with a fresh one before the expiration date. See the label posted on the front side of the control unit. This battery retains the contents of the program and data memories in case a power failure occurs. It is possible to replace the battery without removing power to the control unit.

1) Battery Identification Number
DUNT-5211NCZZ

2) Replacement procedure

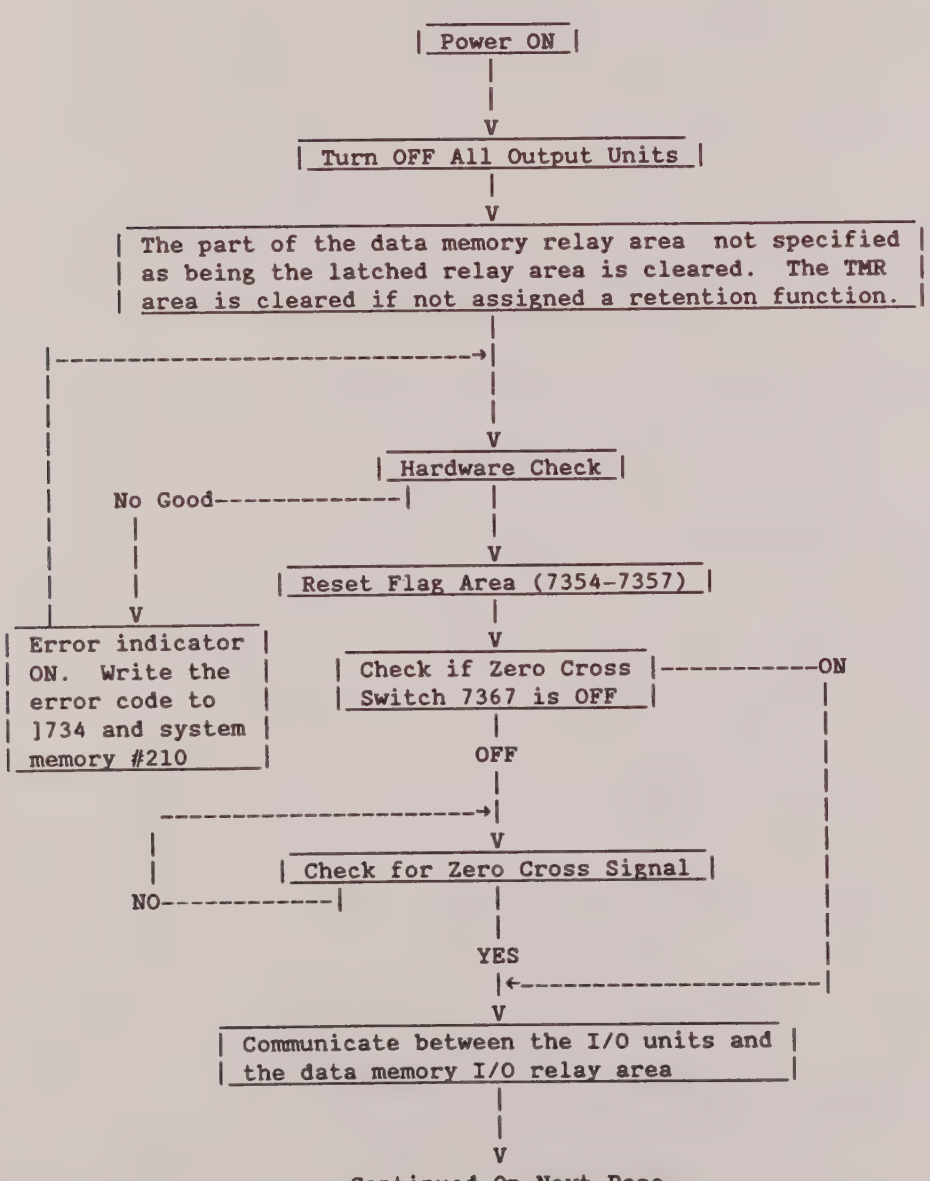

Remove the fuse cover (16).
Unfasten the connector (17) from the used battery cell and fasten it to the fresh battery cell. Take no longer than one minute.
Remove the used battery cell from the battery holder (19) and replace it with the fresh one.
Replace the fuse cover (16) back.
Post the new battery expiration label (14).



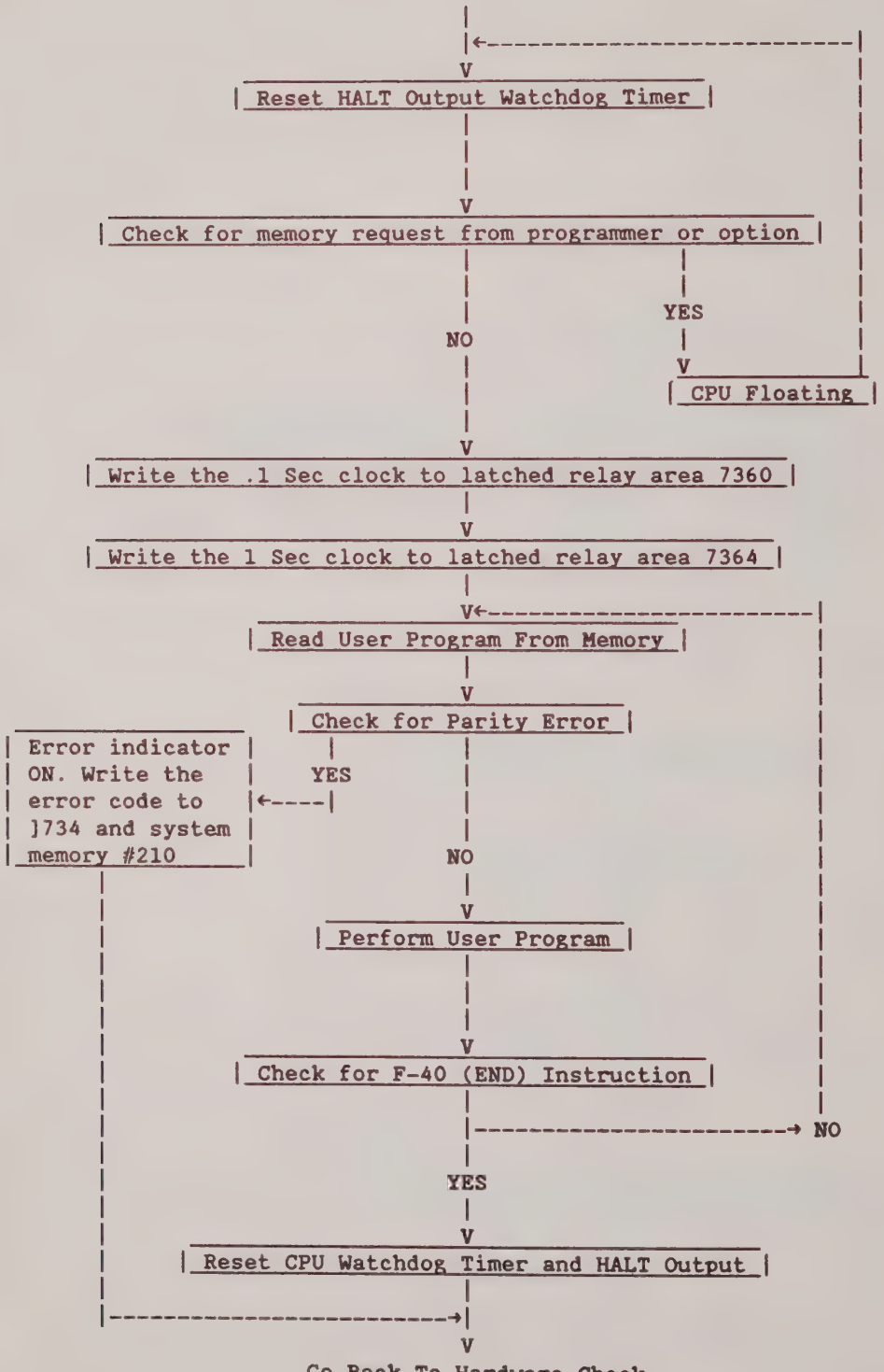
Removing the fuse cover

Replacing the fuse cover

POWER UP AND SCAN CYCLE FLOWCHART

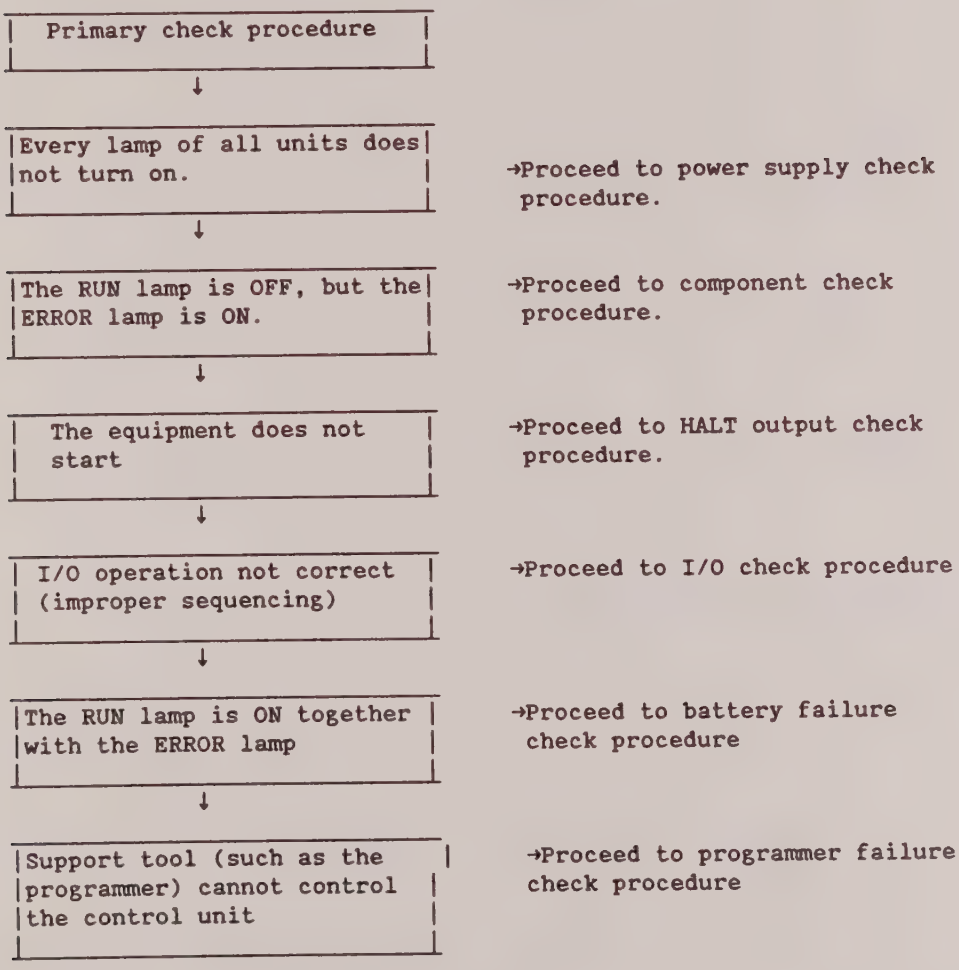

Power ON
Turn OFF All Output Units
The part of the data memory relay area not specified as being the latched relay area is cleared. The TMR area is cleared if not assigned a retention function.
Hardware Check
No Good
Error indicator ON. Write the error code to]734 and system memory #210
Reset Flag Area (7354-7357)
Check if Zero Cross Switch 7367 is OFF
ON
OFF
Check for Zero Cross Signal
NO
YES
Communicate between the I/O units and the data memory I/O relay area

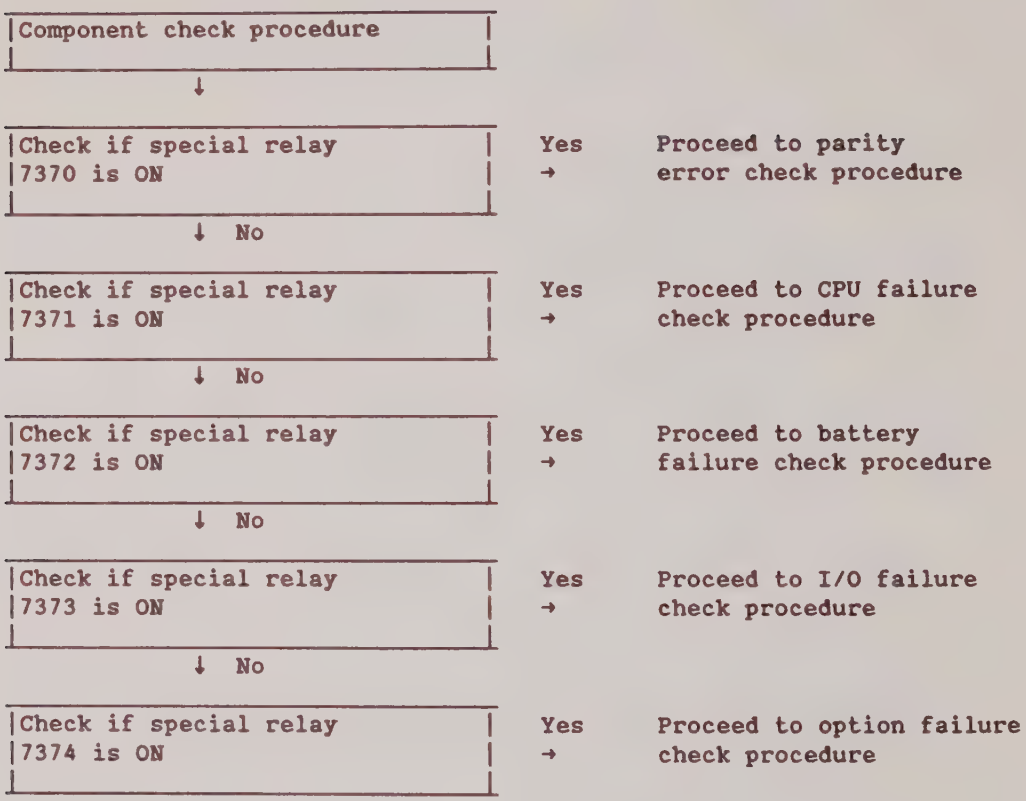
Continued On Next Page

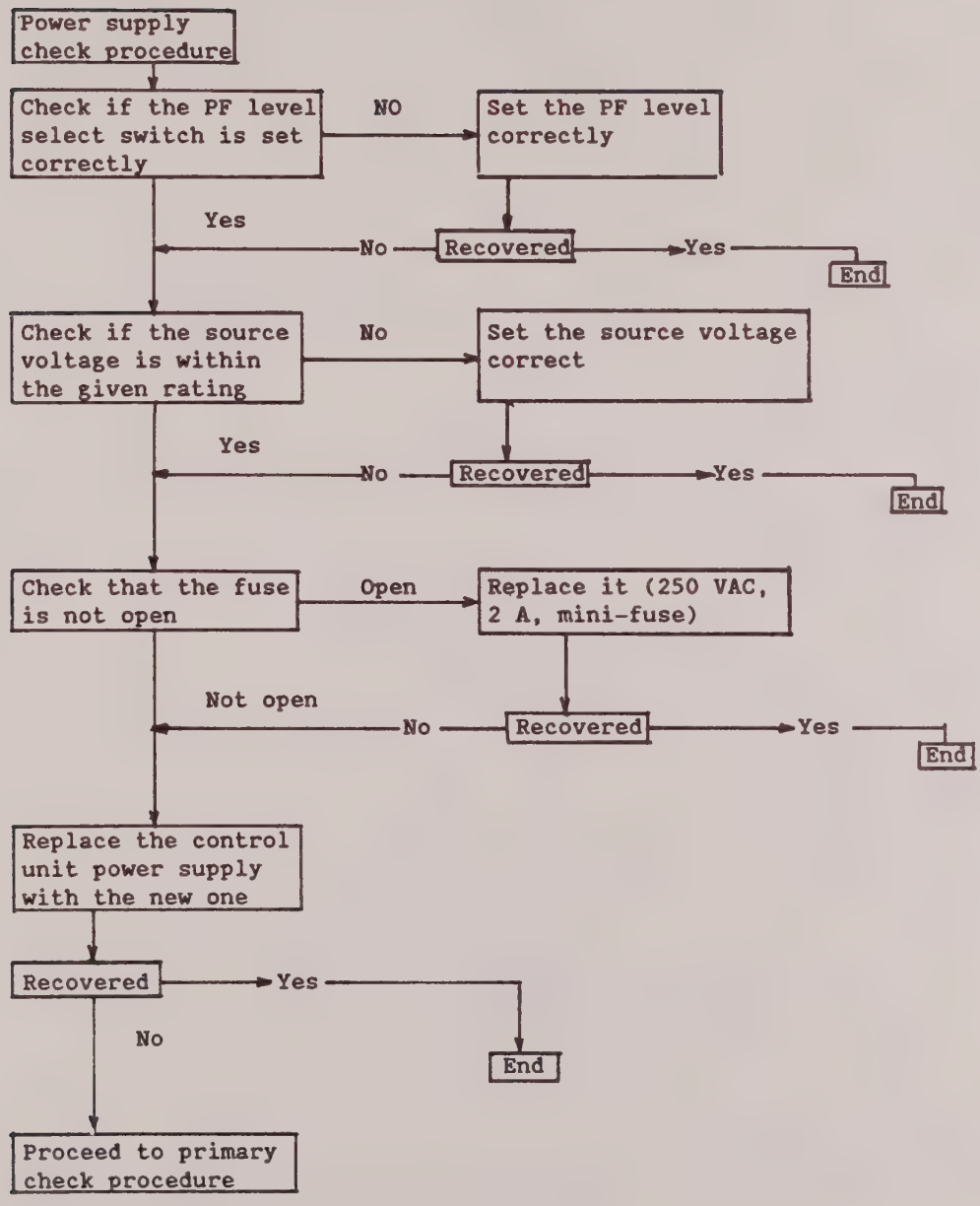

Reset HALT Output Watchdog Timer
Check for memory request from programmer or option
YES
NO
CPU Floating
Write the .1 Sec clock to latched relay area 7360
Write the 1 Sec clock to latched relay area 7364
Read User Program From Memory
Check for Parity Error
Error indicator ON. Write the error code to]734 and system memory #210
YES
NO
Perform User Program
Check for F-40 (END) Instruction
NO
YES
Reset CPU Watchdog Timer and HALT Output
Go Back To Hardware Check

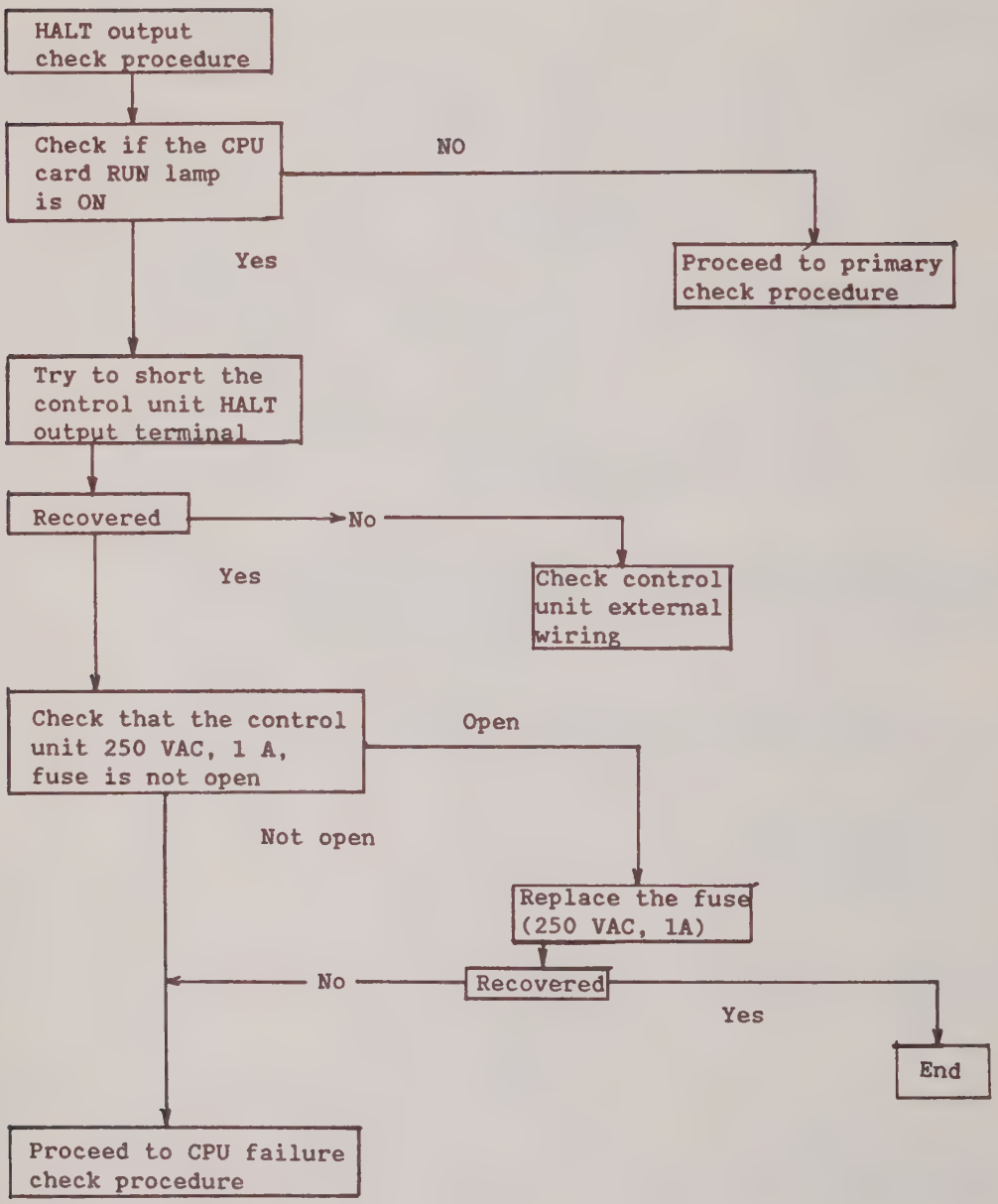
System Troubleshooting

Follow this procedure to track the cause of a failure.


Primary check procedure
Every lamp of all units does not turn on.
→Proceed to power supply check procedure.
The RUN lamp is OFF, but the ERROR lamp is ON.
→Proceed to component check procedure.
The equipment does not start
→Proceed to HALT output check procedure.
I/O operation not correct (improper sequencing)
→Proceed to I/O check procedure
The RUN lamp is ON together with the ERROR lamp
→Proceed to battery failure check procedure
Support tool (such as the programmer) cannot control the control unit
→Proceed to programmer failure check procedure


Component check procedure
Check if special relay 7370 is ON
Yes → Proceed to parity error check procedure
No
Check if special relay 7371 is ON
Yes → Proceed to CPU failure check procedure
No
Check if special relay 7372 is ON
Yes → Proceed to battery failure check procedure
No
Check if special relay 7373 is ON
Yes → Proceed to I/O failure check procedure
No
Check if special relay 7374 is ON
Yes → Proceed to option failure check procedure


Power supply check procedure
Check if the PF level select switch is set correctly
NO
Set the PF level correctly
Yes
No
Recovered
Yes
End
Check if the source voltage is within the given rating
No
Set the source voltage correct
Yes
No
Recovered
Yes
End
Check that the fuse is not open
Open
Replace it (250 VAC, 2 A, mini-fuse)
Not open
No
Recovered
Yes
End
Replace the control unit power supply with the new one
Recovered
Yes
End
No
Proceed to primary check procedure


HALT output check procedure
Check if the CPU card RUN lamp is ON
NO
Proceed to primary check procedure
Yes
Try to short the control unit HALT output terminal
Recovered
No
Check control unit external wiring
Yes
Check that the control unit 250 VAC, 1 A, fuse is not open
Open
Not open
Replace the fuse (250 VAC, 1A)
Recovered
No
Yes
End
Proceed to CPU failure check procedure

I/O check procedure (Procedure is shown in reference to the example on the right.)

To next page

PL does not activate even if PB is pushed

Check if I/O unit 0020 LED is ON

Yes

No

Check if I/O unit external fuse is not open

Open

Replace it

Not open

Monitor OUT 0020 with the programmer to see if ON lamp turns on

Yes

No

Monitor program to check if the program has been changed

Short I/O unit 0020 terminal with common to see if PL turns on

No

Check I/O unit external wiring for open wire and lamp

Yes

Replace the I/O unit

Monitor STR 0000 with the programmer to see if ON lamp turns on

Yes

No

Proceed to CPU failure check procedure

Check if I/O unit 0000 LED lamp is ON

Yes

No

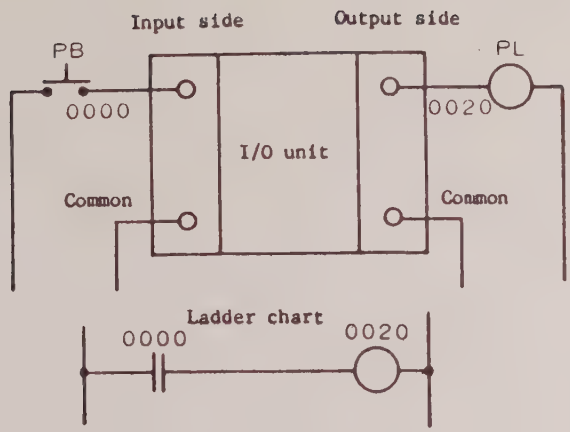
Check if the given voltage is added to I/O unit terminal 0000

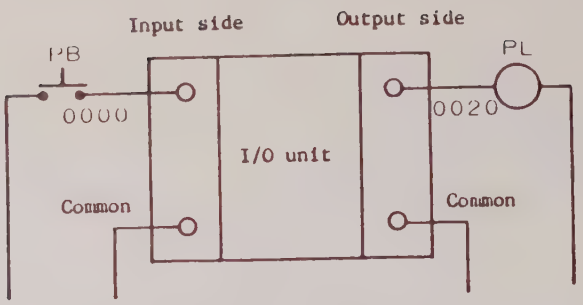
Yes

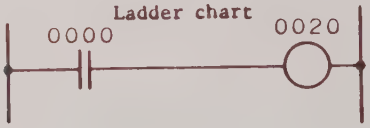
No

Replace the I/O unit

Check I/O unit external wiring for open wire and PB failure







PL lights up without pushing PB

Check if I/O unit LED lamp 0020 is ON

No

Check the I/O unit specification again. In the case of a light load, it may not turn OFF due to leaking current

Yes

Monitor OUT 0020 with the programmer to see if ON lamp lights up

No

Yes

Monitor with the programmer to see if the program has been changed

Replace the I/O unit

Monitor STR 0000 with the programmer to see if ON lamp lights up

No

Yes

Proceed to CPU failure check procedure

Check if I/O unit LED lamp 0000 is ON

No

Yes

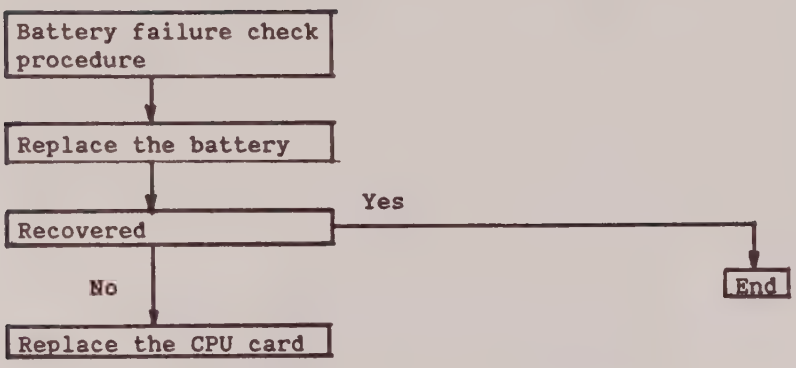
Check if voltage between I/O 0000 terminal and common terminal is 0 V.

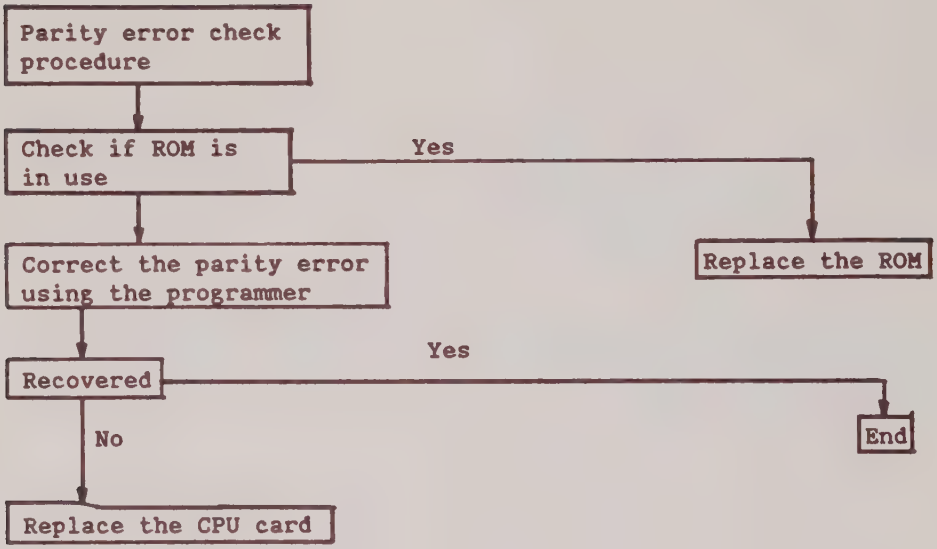
Yes

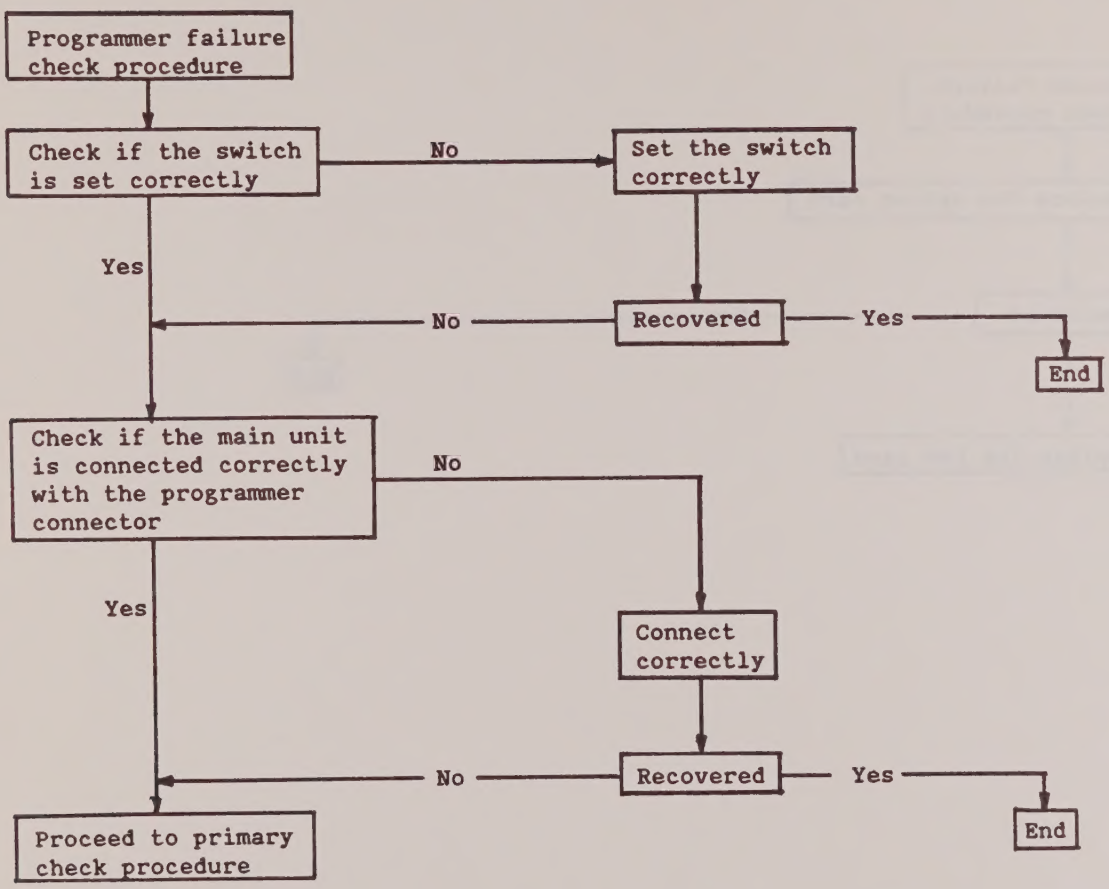
No

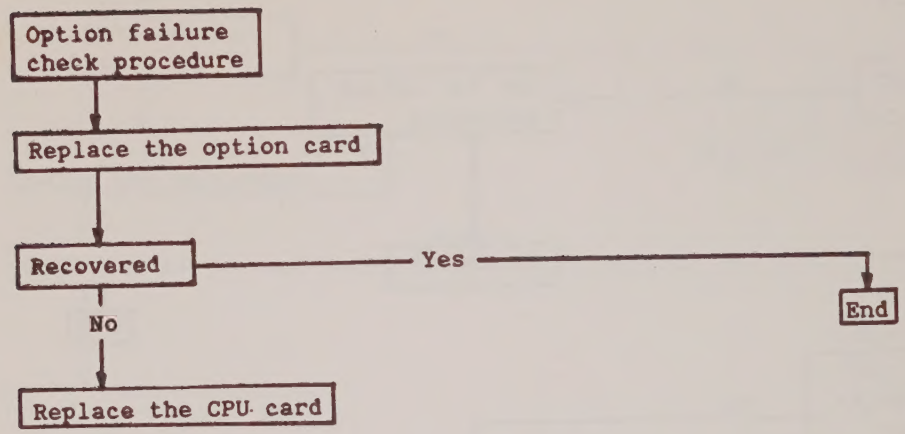
Check I/O unit external wiring for short circuit and PB failure

Replace the I/O unit


Battery failure check procedure
Replace the battery
Recovered
Yes
End
No
Replace the CPU card


Parity error check procedure
Check if ROM is in use
Yes
Replace the ROM
Correct the parity error using the programmer
Recovered
Yes
End
No
Replace the CPU card


Programmer failure check procedure
Check if the switch is set correctly
No
Set the switch correctly
Yes
No
Recovered
Yes
End
Check if the main unit is connected correctly with the programmer connector
No
Yes
Connect correctly
No
Recovered
Yes
End
Proceed to primary check procedure


Option failure check procedure
Replace the option card
Recovered
Yes
End
No
Replace the CPU card

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